ELECTRICAL REVIEW

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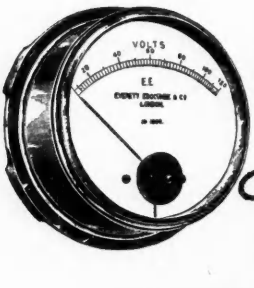
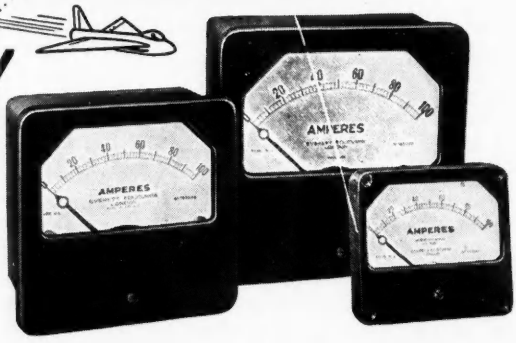


Then

Fifty years
1900 * of Service to the * 1950
Electrical Industry

.....and Now



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ELECTRICAL REVIEW

Vol. CXLVII No. 3807 10TH NOVEMBER, 1950

THE OLDEST ELECTRICAL PAPER • ESTABLISHED 1872

The Men Between

TRAINING OF "ELECTRICAL TECHNICIANS"

ALTHOUGH considerable attention has been given in recent years to the education and training of electrical engineers of professional standard on the one hand and electrical craftsmen on the other, little has been heard of attempts to meet similar needs of those occupying an intermediate position. Owing to the wide range of their functions, their case presents much greater difficulties—difficulties that were evident in the report of the Joint Committee which was presented by Sir Arthur Fleming last week at the Institution of Electrical Engineers.

Greater Numbers

These men in between, referred to in the report as "electrical technicians," can fairly be described as the backbone of the industry, which, it has been estimated, requires their services in the numerical ratio of five to one of the "professional" type at the head. The recruitment of those with adequate qualifications is therefore a vital and urgent national necessity. The generally somewhat haphazard methods of their education and training in the past will no longer serve in view of the rapid growth of the industry and keener competition from other exporting countries.

The Joint Committee makes no claim to do more than provide a general guide to basic principles. Its report should be read in conjunction with that of 1947 relating to the training of professional engineers. Otherwise it might be supposed that its recommendations tended towards the setting up of a priestly caste of professional engineers, who, having undergone in youth a prescribed form of initiation, had thereby established a right to the exclusive use of the term "engineer."

Convenient as the use of the word "technicians" may be in a report of this kind, it should not be allowed to convey any implication that those so styled are not engineers in the real sense of the word. That would assuredly not encourage recruiting. Moreover technicians are stated in the report to be the product of a combination of theoretical and practical knowledge and experience—a description that would cover any engineer.

"How" and "Why"

Still more unfortunate is the statement that professional engineers are concerned with "why a thing works" while technicians are concerned with "how it works"—formerly regarded as roughly expressing the difference between scientists and engineers. This definition, we believe, would rule out the majority of I.E.E. members, not to mention the

great names of the past, who conceived their duty primarily as the application of technology. It would also, no doubt, often lead to the subordination of professional engineers to technicians, who might as a result of their different approach prove more suitable for promotion to positions of executive authority. Technicians are advised to join suitable associations, but it is surely desirable that they should also come into the fold of the Institution, which might make something more of its associate class. Apart from the foregoing criticisms, which were implied in several contributions to the discussion, the report contains many wise *obiter dicta* on education and technical training in general. While presenting no cut and dried solution to the problem, it provides much to stimulate thought on human aspects which will no doubt crystallize later into more definite proposals.

POWER SHORTAGE

The fears of intensified power shortage expressed in our leading article of 22nd September are being justified almost daily. The low morning temperatures have already necessitated extensive power cuts. A recent cut in Birmingham led the secretary of the Midland Regional Council of the National Union of Manufacturers to say that his Council did not know how the Government expected manufacturers to carry on with the production of armaments when power cuts were imposed. We are afraid that the need for speeding up power station construction will become increasingly apparent this winter.

OVERHEAD LINE CONTROVERSY

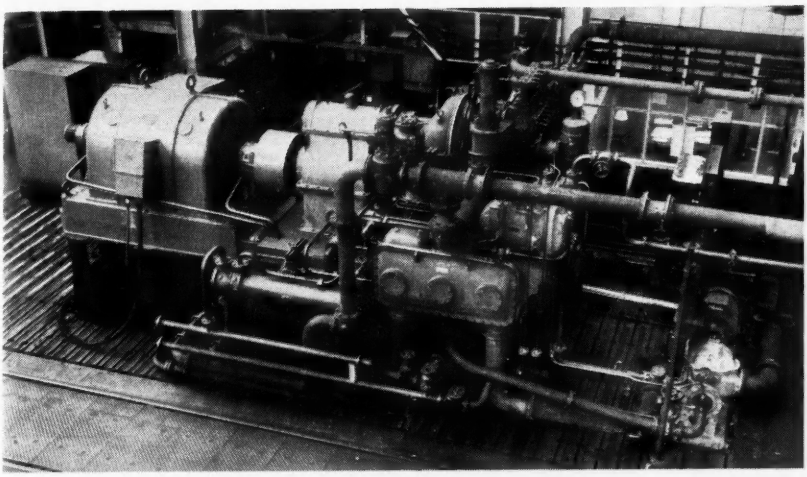
The Midlands Electricity Board's efforts to take a supply to the rural parts of Herefordshire continue to meet with stubborn opposition. When the Minister of Fuel and Power turned down the proposed overhead line across the Malvern Hills he intimated that he would be prepared to consider an alternative scheme. New proposals now put forward are said not to affect so many authorities, but the Worcestershire County Council thinks that the line—via the Pink Cottage valley, a noted beauty spot—would do more harm to the amenities than the one originally proposed. From the Board's point of view also the route is less attractive, being longer and consequently more expensive. The County Council concludes that the only satisfactory solution would be to lay the cable underground, holding that the extra cost of £19,000 is a small price to pay for preserving the profile of the hills. The same could be argued individually for other schemes, but the cumulative result would be a considerable additional burden which electricity consumers should not be called upon to bear.

ADVICE TO TENANTS

A good deal of common sense characterizes a report just published for the Ministry of Health, " Care of Fittings and Equipment in the Modern House," which is reviewed in this issue. The section on electrical appliances contains much good advice which it would pay local authorities to give and their tenants to act upon. A number of ways in which installations and equipment are habitually abused are pointed out and there are repeated warnings to those householders who fancy themselves as electricians. Our only criticism of the recommended advice is that there is rather a lot of it for a tenant to read and digest. Not so full, but probably sufficient, were the instructions given in the E.D.A. pamphlet on " Electric Service in Temporary Houses " published three or four years ago. This is now out of print but might be worth re-issuing in a revised form for the use of local authoriities.

UNSKILLED WIRING

In the October issue of " The Crabtree " (J. A. Crabtree & Co.) a writer mentions the devices now available to reduce installation work. He says that in North America this tendency has been so closely harnessed to standardization that very little skill is required for domestic installation work. On a recent visit to Canada he inspected an estate of 300 houses in which the wiring was being carried out by a score of unskilled men under one qualified electrician. It is questionable, we think, whether the E.T.U. would allow this to happen in England however desirable it might be. But is it desirable? The writer admits that this " packaged wiring " is not always a sound engineering job but says that so far as the user is concerned it works satisfactorily. The questions arise: Does it continue to work satisfactorily? And is there no danger if the installation is not a " sound engineering job? "



Unusual Turbo-Alternator

Plant for Installation at Beckton Gasworks

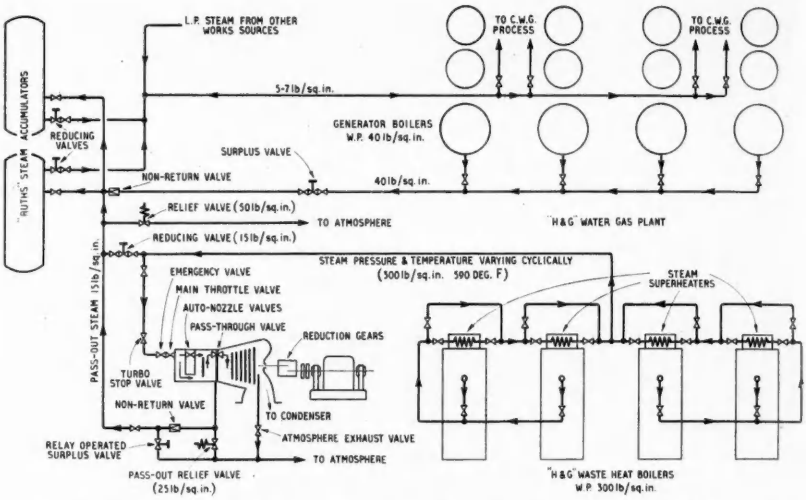
ON a visit to the Bedford works of W. H. Allen, Sons & Co., Ltd., last week we saw a demonstration of a 1,390 kW pass-out condensing turbo-alternator designed to suit unusual conditions. It incorporates special governor gear and is being supplied to the order of Humphreys & Glasgow for installation at the Beckton Works of the North Thames Gas Board, where it is to operate in conjunction with a large water gas producing plant. Water gas is generated by blowing air through a hot coke bed, thus raising its temperature preparatory to the steam run when steam is passed through the fuel to produce the gas.

Thus the process will be cyclical, the air blow being of about 1 min duration and the steam run about 2 min. During the air blow a large amount of waste heat will be generated, and this will be used in waste-heat boilers to raise steam at 290lb gauge to drive the turbine, which in turn will provide steam at 15lb gauge to supplement other sources for use in the steam run. The set is provided with a condenser, as the high-pressure steam generated in the waste-heat boilers will be in excess of that required from the turbine.

With one unit of gas-making plant in use, a time cycle of about 3 min is involved, but as there are four units and the operation of individual units is staggered, the time is reduced to $\frac{1}{2}$, $\frac{1}{3}$ or $\frac{1}{4}$ of this depending on the amount of gas-making plant in use. These cylical fluctuations give rise to sympathetic fluctuations in steam supply and temperature. The demand for process steam is also cyclical.

The plant has to run with the utmost reliability and requires the minimum of skilled attention as several automatic safety devices have been incorporated. On the advice of the electrical consultants, Mackness & Shipley, an induction alternator manufactured by Lancashire Dynamo & Crypto, Ltd., has been supplied, which is driven through reduction gearing by the 6,000 r.p.m. turbine. The total electrical load of the gasworks is much greater than the output of the turbo-alternator, so the usual objections to an induction alternator are not of great importance.

The main advantage of this type is its robustness and the fact that it can be paralleled more easily than a conventional synchronous machine. However, as the full-load slip of the alternator is only 1 per cent,



Steam flow diagram for the Beckton set as arranged on site in conjunction with the water gas installation

an instrument is required to ensure that the machine is switched in at not less than synchronous speed, and not more than 1 per cent above it. Furthermore, to avoid heavy transient magnetizing currents, a current limiting reactor is put in circuit when the machine is switched in and short-circuited before loading. The necessity for this reactor is not dictated by the alternator, but by the characteristics of the supply system to which it is connected. The turbine is unaffected.

Governor Gear Operation

Before discussing the governor gear, it should be pointed out that so far as the turbine governing system is concerned, it does not matter whether the alternator is, as in this case, of the induction type or of the synchronous pattern with an exciter. The only essential is that the machine shall run in parallel with an electrical system of sufficient capacity to ensure a reasonably constant speed. The system works equally well with d.c. generators.

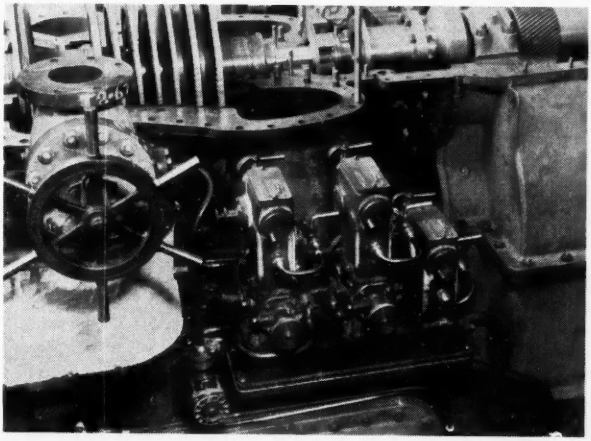
The governor gear is so designed that the inlet of steam is controlled by the pressure in the waste-heat boilers, a fall in steam supply pressure serving to close the turbine control valves and vice versa; the net result is to maintain boiler pressure constant. This makes available a maximum heat drop for use in the turbine and the additional provision of automatic nozzle control valves in association with the inlet pressure governor ensures that full use is made of the available heat drop.

As it would be undesirable to maintain the boiler pressure absolutely constant, a lost motion relay has been fitted to prevent operation of the inlet steam control valves due to cyclical variations in pressure. The gear takes up a mean position from which it can be moved only by a sensible alteration in gas-making load. By reason of the action of this device the boiler becomes in effect a steam accumulator and the rate at which steam is drawn off is substantially constant over the cycle. In consequence, the pass-out rate is also practically constant, but as the demand for process steam is cyclical and out of step with waste-heat production, Ruths steam accumulators are installed in the pass-out main to even out the difference between supply and demand. The pressure within the accumulators, and hence the pass-out pressure, will fluctuate cyclically and a further lost motion relay is embodied in the pass-out regulating gear to render the pass-through valve unresponsive to cyclical variations in pass-out pressure.

From the drawing of the layout of the governor gear it can be seen that oil is

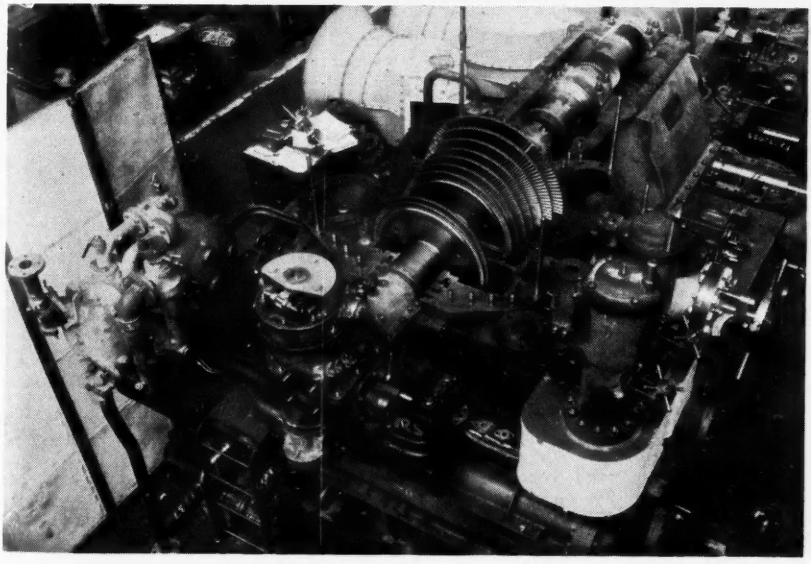
delivered by two pumps, one for lubrication at 10–15lb and the other for governor operation at 50–60lb pressure. High-pressure oil is delivered to the steam inlet regulator pilot valve, from which it is led to a lost motion relay. An increase in steam pressure reduces the operating pressure on the piston of the lost motion relay, which floats by an adjustable amount equivalent to a pressure variation of about 7lb/sq in before operating an associated pilot valve. This receives h.p. oil from the speed governor and as this is normally out of action, the full pressure of governor oil is available at the lost motion relay pilot valve. The outlet oil from the lost motion relay pilot valve controls the main throttle valve of the turbine, and through it the automatic nozzle control valves.

The lost motion relay associated with the



Right: Inlet pressure and pass-out regulators, with associated lost motion relays, and pressure regulator controlling the pass-out surplus valve

Below: View of machine with top covers removed showing pinions and gear, rotor and diaphragm bottom halves in position, speed governor, air pump (on left) and steam chest and main stop valve (on right), as well as the condenser, which forms the turbine baseplate

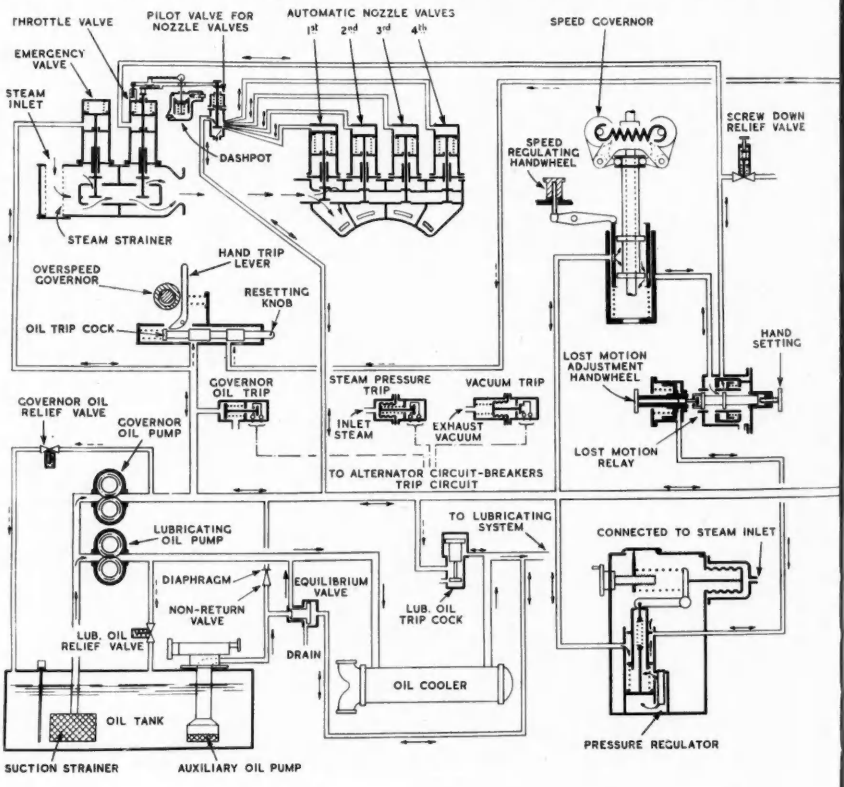


pass-out pressure regulator is the same as the one in the inlet regulating system, but its piston floats by an amount equivalent to a pressure variation of 0·75lb/sq in.

The set runs in parallel with a 50 c/s supply, but allowing for a maximum possible frequency of 52 c/s the no-load speed of the four-pole alternator is 1,560 r.p.m., the full-load speed being 1,574 r.p.m. on account of the negative slip of the induction machine. The speed governor is ineffective until the alternator reaches 1,600 r.p.m. when it begins to override the inlet pressure regulator and progressively close the steam inlet valves to the turbine until at 1,670 r.p.m. all steam, apart from a small amount of ventilating steam, is cut off. The speed governor, therefore, acts as a pre-emergency governor should the electrical link be broken and will prevent the shutting down of the turbine except in cases of real emergency. The emergency overspeed governor is of the conventional unbalanced ring type, arranged to release governor oil pressure and so close the main emergency stop valve. This trip can also be hand operated.

Operation of the turbine emergency trip system by hand or on overspeed shuts down the turbine but leaves the alternator connected to the supply and the set will be motored at sub-synchronous speed. To prevent this, a trip switch is arranged to operate the alternator circuit breaker on failure of governor oil pressure. An additional refinement is a lubricating oil trip cock.

The m.c.r. of the machine (1,390 kW) corresponds to maximum steam production of 26,000lb/hr from the waste-heat boilers and a normal pass-out demand of 10,800lb/hr. Under these conditions, the steam flow through the l.p. section of the turbine to the condenser would be 15,200lb/hr. If the



pass-out steam demand should be reduced the pass-out pressure would rise, the l.p. steam flow would increase and more power would be generated by this section of the turbine. This would increase the output of the set above the maximum continuous rating. To prevent the resultant electrical overload on the alternator a finely controlled surplus valve is fitted in the pass-out connection to release pass-out steam to atmosphere when it reaches 16 lb gauge.

As the steam supply for the turbine is taken from waste-heat boilers there might be a risk of failure of the supply in whole or part, so a Maclaren steam-pressure trip switch is arranged to operate when the pressure falls below a predetermined level and trip the alternator circuit breaker. It is not possible or desirable to arrange for the contacts to close precisely when the control valves are closed, but provision has been made for a little ventilating steam to by-pass the control valves and cover such conditions of working. As an additional safeguard, a similar device is fitted to trip out the alternator if the vacuum fails.

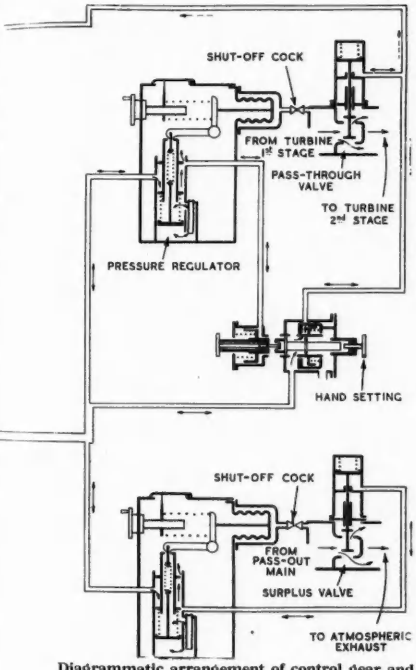
The turbine itself is of normal impulse design, with a two-row velocity compounded h.p. section upstream of the pass-out point, followed by an l.p. section exhausting to the condenser and comprising seven pressure-compounded stages.

Starting and Paralleling

The starting up and paralleling of the machine presents some interesting points. The alternator is of high efficiency and its full-load speed is only 1 per cent above synchronous speed. So as to avoid shocks on the gears and flexible couplings the speed is brought within the limits of synchronous speed and 1 per cent above it before switching in.

Assuming that vacuum has been raised and all the usual preliminaries have been carried out, the turbine is started on the main steam by-pass valve and the speed is adjusted within the limits mentioned above by means of a double-element frequency meter. A delayed action push-button on the electrical control panel is then depressed to put the steam pressure trip temporarily out of action, and following on this, the main circuit breaker closing switch on the electrical control panel is moved to "Close." The alternator is then switched in with the reactor in circuit. The hand operated reactor shorting switch is then closed, care being taken to see that the speed of the set is still within the prescribed limits. The usual electrical interlocks are provided so that, for example, the reactor shorting switch will open should the main circuit breaker be tripped. The inlet pressure regulator is then put into action and the steam stop valve opened when the set will immediately generate. Finally, the pass-out gear is put into operation, and the pass-out sluice valve opened to admit l.p. steam to the accumulators and thence to the water gas process.

If the starting procedure is carried out expeditiously, the delayed action push-button restores the steam pressure trip circuit to normal without event. Should this happen, however, before the steam stop valve has been opened, the alternator will be tripped out. Under steady state conditions the power generated is determined solely by the boiler waste-heat intake, which, when the gas-making plant is started up, is at a reduced level.



Diagrammatic arrangement of control gear and oil systems

NEW BOOKS

The Magnetic Amplifier. By J. H. Reyner, B.Sc., M.I.E.E. Pp. 119; figs. 72; index. Stuart & Richards, 10, Bramerton Street, London, S.W.3.

This little book sets out in simple language the basic principles upon which magnetic amplifiers operate. The treatment is from the physical rather than the mathematical point of view and the book is therefore to be recommended to students and anyone who is beginning on the subject. The more mathematical and erudite aspects are not covered but references to more advanced work in Sweden, Germany, U.S.A. and this country are given at the end of the book.

The explanation of transductor operation is based on the now widely-used assumption of B-H curve consisting of three linear zones. In Chapter 3 further simplification beyond that previously attempted is given, but the treatment may be misleading because the argument is developed and results plotted in terms of peak current and voltage. The ampere-turn balance is true only if "mean" values are considered. There are also useful chapters on magnetic materials, practical design and construction.

The idea of response time is introduced and an analysis leading to the simple formula for the amplifier time-constant is given. This is of considerable practical importance and even in an elementary text book, more detailed consideration would have been welcome.

In the last chapter the characteristics of the magnetic amplifier are reviewed from the point of view of practical applications. A number of examples including a photo-electric counter, an automatic pilot and a voltage and frequency controller for a motor-alternator are described. Circuit diagrams and photographs add considerably to the value of the book. On the whole this is an excellent book, admirably achieving what it sets out to do.—H. M. G.

Electric Fuses. By H. W. Baxter, B.Sc., A.M.I.E.E. Pp. 199; figs. 138; index. Edward Arnold & Co., Ltd., 41, Maddox Street, London, W.1. Price 21s.

This book will be welcomed by anyone who has to concern himself with the design, testing or applications of fuses as this is the first time that it has been possible to obtain a full discussion of the subject within a single work. The present volume is largely based on reports issued by the E.R.A. to members, and sometimes to non-members. These are now gathered together, and additional material has been added. A desirable, but rather unusual feature, which has presumably been retained from the original reports, is that most chapters end with a short summary of the principal conclusions.

The first chapters are devoted to the widely used semi-enclosed fuse assembly and include breaking capacity tests. Studies of pre-arcing phenomena in wires mounted vertically in air are described and from this point onward, the emphasis is on the cartridge fuse, including the effects of various fillers. The effects of physical dimensions and circuit constants are described and there follows a lengthy section on arcing phenomena in d.c. circuits. A shorter section on a.c. circuits considers the variations from the d.c. case, but the results are stated to be much less consistent. Moreover, d.c. tests on fuses intended for a.c. circuits are unsatisfactory.

The concluding chapters deal with composite fuses, the use of scaled down model tests and test equipment generally. Fuse regulations of the principal national standardization bodies are given in tabular form, and there is also a short bibliography.—P. L. D.

Slide Rules. By W. A. Surfleet, A.M.I.Mech.E., A.M.I.E.E. Pp. 56; figs. 10. H. F. Bicknell, 32, High Street, Dover, Kent. Price 2s., postage 3d.

Considering the value of the slide rule to engineers, it is surprising how many have not mastered its manipulation. This inexpensive little book provides a clear and concise explanation of all aspects of slide-rule operation and can be thoroughly recommended to both engineers and students alike.—R. P.

Books Received

Atomic Energy. By R. E. Peierls. Pp. 200; figs. 24; index. Penguin Books, Harmondsworth, Middlesex. Price 1s 6d.

Electric Power System Control. Third Edition. By H. P. Young. Pp. 456; figs. 319; index. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2.

Elektrische Starkströmanlagen. By Emil Kosack. Pp. 356; figs. 320; index. Springer-Verlag, Berlin. Price 12.60 marks.

H.F. Induction Furnaces

Physical Metallurgy Research Equipment

THE newly installed high frequency induction furnaces at the A.E.I. laboratory, Aldermaston Court, Berkshire, are to be used for melting and heat treatment processing in physical metallurgy investigations. They are compactly designed and operate " cleanly " and safely, deriving their input from a motor-generator in a small substation.

The squirrel cage motor of 65 h.p. at 400 V and 3,000 r.p.m. drives a 10,000 c/s heteropolar single phase alternator of 35 kW at 300 V, both on a common shaft with a steel bedplate on anti-vibration blocks. Cool air enters through a louvre in one of the walls and hot air is discharged through sheet metal trunking to an external chimney, thus reducing noise.

Cables run underground in earthenware ducts from the substation to the laboratory. The generator h.f. output cables go to an isolating switch in the room containing condensers for power factor correction. Cables from the motor starter and generator field winding go to a control panel which faces and is accessible from the furnace room. On the front of the furnace control panel is a push-button for stopping the driving motor and a handwheel for regulating the rheostat that controls the rectifier furnishing d.c. for the machine field circuit.

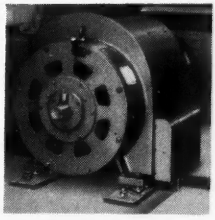
The p.f. correcting condenser bank, oil immersed and rack mounted, is connected to multiple copper strap busbars which are rated to carry the maximum furnace current and closely interleaved to minimize eddy current loss. They go to a changeover cubicle having four switching positions for connecting any of the four furnaces to the h.f. busbars. A generator series condenser, having equal reactance to that of the generator itself, compensates for the voltage variations set up during condenser switching.

All switching and control are effected from the furnace room control cubicle, which is raised so that its base is level with the platform surrounding the vacuum furnace. On the front panel are signal lamps, indicating instruments and so on. Nearby is a small vacuum control box, which controls the pumps associated with the vacuum furnace.

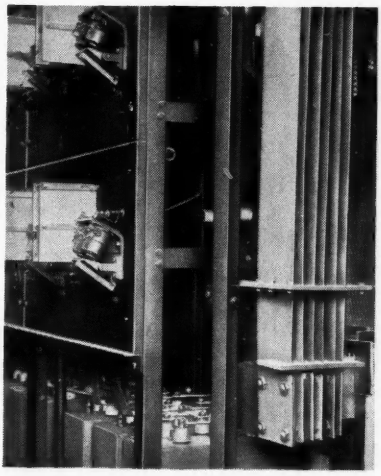
The condenser room is isolated from the furnace room by an expanded metal screen ; the door key is kept on the front panel of the furnace cubicle. If the key is removed, the generator contactor is tripped automatically, so that the condenser room can only be entered when the h.f. circuit is open. A similar device for the doors of the changeover cubicle prevents the furnaces from being switched over until the h.f. supply is interrupted.

There are four coreless induction furnaces, one for sintering processes in vacuum, the other three for melting metals in air. The coil of the vacuum furnace is inside a steel vessel, which rises above the platform. Underneath are vacuum pumps, inter-

Right : Single phase high frequency motor - generator showing ventilating ducting



Below : Contactor panels with condenser cans below and (on right) busbar connectors



connecting pipework and a water pump for cooling. An overhead runway carries a chain pulley block for lifting the steel cover of the vacuum vessel while the charge is loaded into the furnace.

One melting furnace is hand tilted, and is able to melt 20lb of metal in as many minutes. The heavy current terminal connections are special and also allow the circuit to be broken quickly and easily when the furnace is tilted. The furnace coil leads are connected to a set of knife-edged moving copper contacts (on the underside of the furnace box) which press on to a set of flexible stationary contacts to which the copper connections from the condenser busbars are bolted at the back of the furnace, with the rubber-hose water connections. A small interlock switch, operated by the tilting of the furnace box, trips the main generator contactor if the high frequency power is left on when about to pour molten metal.

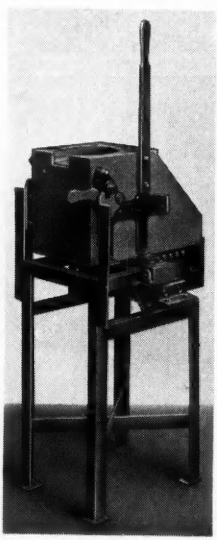
A very small furnace for melting several ounces of metal is mounted on a table connected by flexible cables to the changeover switch cubicle. The charge is placed in a refractory crucible assembled inside the furnace coil; within a few minutes of switching on the metal becomes molten. By using appropriately designed induction coils, it is possible to carry out brazing and similar processes.

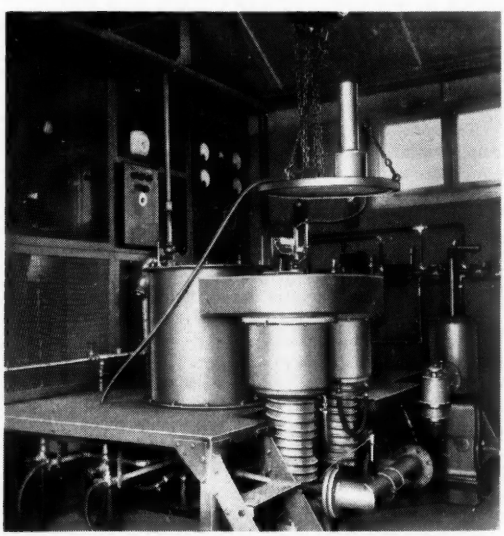
All the furnaces and the vacuum equipment are water cooled, independently of the town mains. A motor-driven pump and an outdoor cooler with motor-driven fan are capable of passing 360 gall/hr continuously through the cooling system. Water-flow relays have adjustable electrical contacts, connected through an auxiliary relay to the operating coils of the generator contactor; thus in the event of water failure the h.f. circuit will open automatically and a red lamp light up.

The metalclad switch-fuses and starters for the pump motors and cooler fan are on a distribution board in the furnace room; the water flow relays are adjacent.

The vacuum plant consists of a motor-driven rotary pump and two "Metrovac" oil diffusion pumps, the latter using "Apiezon" low vapour pressure oil as the working fluid. The rotary pump exhausts to atmosphere and evacuates down to 10^{-2} mm of mercury. The oil diffusion pumps, which are connected directly to the vacuum vessel containing the furnace coil, reduce the pressure still further to 10^{-4} or 10^{-5} mm of

A hand tilted 20lb metal melting furnace and (right) part view of furnace room showing vacuum furnace platform with vacuum pumps and control cubicle





mercury. A high-duty vacuum valve is between the rotary and diffusion pumps.

In the control box is an adjustable vacuum relay operating an auxiliary contactor which closes the heater circuit when the pressure is 100 microns, or less, and opens again when it exceeds 150 microns, so that the diffusion pumps are only utilized when required. The water flow relays for the pumps have adjustable electrical contacts connected (*via* the vacuum control panel) in the circuit of the oil diffusion pump heaters and the rotary pump motor starter. There is also a hand-operated control switch for switching the oil diffusion pump heaters on or off. On the front of the control box are coloured signal lamps.

During the sequence of starting operations for melting, or heat-treatment, an auxiliary contactor (which is kept closed by retaining contacts) provides that (1) the cooling water for the furnace is flowing, (2) the master keys are in position in their controllers on the cubicle panel, (3) the field rheostat is in the "all-in" position, (4) the auxiliary contacts on the furnace changeover switches are closed to the required furnace position, and (5) in the case of the hand tilting furnace that the interlock switch is closed so that the furnace is in the down position.

Condenser units are switched in or out according to the indication of the reactive kVA instrument, but this cannot be done until the generator field circuit has been opened (automatically by the rotary switch) to lower the voltage of the h.f. circuit and protect the condensers against surges during switching operations. Yellow signal lamps indicate the particular condensers in circuit.

The generator winding is protected against over-current by a relay, which trips the generator contactor ; on over-voltage another relay lights a red lamp and the field rheostat can then be adjusted to lower the voltage.

Operation and control are as simple as possible ; visible indication of the state of the whole plant is provided at every stage of the metallurgical process. The whole is safeguarded against carelessness in operation and faults. Such equipment can be made by the Metropolitan-Vickers Electrical Co., Ltd., suitable for many industrial purposes. Examples are the mass production of small castings of ferrous and non-ferrous alloys and of ingots of crucible quality, the brazing and hardening of small detail parts, the sintering processes used in powder metallurgy, the melting and pouring of special high-grade metals and alloys in vacuum or in protective atmospheres.

Care of Domestic Equipment

Advice to Tenants

IN 1948 the Central Housing Advisory Committee set up a sub-committee "to consider what advice could be given to local authorities on the care and maintenance of new types of internal fittings and equipment." The sub-committee's report has now been published for the Ministry of Health under the title "Care of Fittings and Equipment in the Modern House" (H.M. Stationery Office, 60 pp., price 1s 6d) and it contains among a mass of matter a section on the care of electrical equipment. The large amount of equipment now put into houses by local authorities represents a potential source of considerable future expenditure on maintenance and the sub-committee hopes that this may be reduced by the authorities advising their tenants on lines which it suggests.

A generous interpretation of the word "new" in the terms of reference has been adopted. Electrical appliances already in common use before the war are covered: it is explained by the sub-committee that they are often new to tenants of council houses.

Mention is made of the educational as well as "promotional" activities of the electricity supply authorities whereby the housewife is instructed how to use and look after her appliances. The unsatisfactory character of some immediate post-war equipment is obliquely referred to and the sub-committee also found as another source of trouble the fact that "many tenants have a strong but sadly misplaced confidence in their electrical ability," resulting in "unorthodox" handiwork and overloaded circuits. Installations in temporary houses based on a ten-year life have raised acute maintenance problems and regular inspection is advocated.

Some very good "advice to tenants" is suggested to local authorities. In this way the operation and care of the installation generally, cookers, clothes boilers and refrigerators are covered in sufficient detail. Tenants are to be warned against doing more than replacing fuses ; anything further should be done by an electrician. The use of lampholders for heavy-current appliances is properly deprecated.

Chocolate Cooling

Operations Accelerated by Refrigeration

A REDUCTION in the time taken to cool slab chocolate from 3–4 hours to 22 minutes has been achieved by the installation at the Helm Chocolate Company's factory at Wallington, Surrey, of a refrigerated tunnel system. A considerable amount of labour has also been saved.

After blending in mixing vats, the chocolate is passed to warming pans and fed automatically through metering taps to moulded trays beneath. These trays are fed on to a conveyor line, which is vibrated to shake the warm chocolate into an even form on the mould, and then loaded on to aluminium trolleys each holding eighty complete moulds.

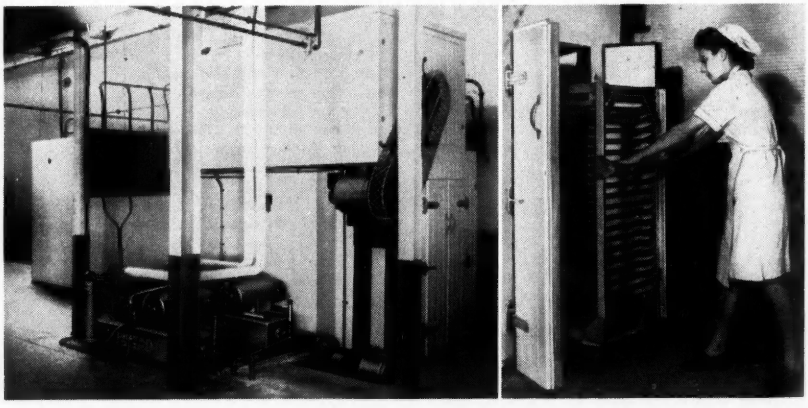
These trolleys are loaded into the 22ft long refrigeration tunnel and travel at a rate of 1ft per minute through it. Red and green lights indicate whether the tunnel is full or whether there is room for another trolley. Leaving the tunnel, the trays are taken from the trolleys and the chocolates are removed either by vibration or by hand ready for wrapping and packing.

Before the new tunnel was installed a refrigeration chamber was used with a cooling fan blowing from each end. The trays were loaded into racks along the sides of the chamber and after cooling were removed by hand individually. They were not in a compact form for further handling as is the case with the new system.

Required to cool 1,200lb of chocolate per hour from approximately 88 deg F to 50 deg F, the new tunnel is designed to give an air flow of 6,000 cu ft per minute and an air temperature down the tunnel of 42–45 deg F with a relative humidity of approximately 80 per cent and with an ambient temperature of 80 deg F. The tunnel is insulated with 3in of slab cork throughout. The condensing units consist of two "Prestcold" WR 500 fully automatic water cooled condensing units incorporating PS 500 compressors driven at 450 r.p.m. by 5 h.p. s.c. motors. Both units are equipped with twenty-two tube condensers requiring about 350 gallons of water at 60 deg F per hour of operating time.

Refrigeration & General Utilities, Ltd., were responsible for carrying out the new installation, the Instalectric Company devising the scheme of signals and undertaking the electrical installation.

Compact layout of the refrigerating tunnel and "Prestcold" units and (right) trolley being removed from the refrigeration tunnel



PERSONAL and SOCIAL

News of Men and Women of the Industry

THE South Western Electricity Board has appointed **Mr. W. F. Sandry,** of Carn Brea, as Cornwall Sub-Area accountant in succession to the late Mr. A. L. Gray. Mr. Sandry joined the Cornwall Electric Power Co.'s accountancy staff as a cost clerk in 1911, and except for service with the Royal Engineers, remained with the company, becoming first assistant to the chief accountant in 1929. When the company vested in the Board, Mr. Sandry was appointed deputy accountant for the Cornwall Sub-Area.

By agreement between Rootes, Ltd., and the Plessey Co., Ltd., **Mr. E. J. Earnshaw,** M.A., A.M.I.E.E., A.F.R.Ae.S., has been released by the former company to undertake duties in the aircraft industry. In consequence, at a meeting of the directors of the Plessey Co., on 29th September, Mr. Earnshaw was appointed a director of the company with effect from 2nd October.

Mr. E. J. Earnshaw

Following the illuminating engineering final examination (section B) of 1949, the first prize silver medal has been awarded by the City and Guilds Institute to **Major P. D. Figgis,** T.D., who is with the B.T.H. Lighting Department.

The private address of **Mr. E. A. Fowler,** who has recently taken up the appointment of chief commercial officer to the Eastern Electricity Board, is now The Haven, Foxgrove Gardens, Felixstowe, Suffolk (telephone : Felixstowe 1002).

Mr. J. Terry, A.M.I.E.E., has resigned his position with the Ever Ready Co. (Gt. Britain), Ltd., with whom he has been associated since 1932, to take up an appointment with Tube Investments (Group Services), Ltd., Birmingham. During the war Mr. Terry served with R.E.M.E. in the Middle East and Italy, being released in 1945 with the rank of lt.-colonel.

Mr. V. A. Fazalbhoy, managing director of General Radio & Appliances, Ltd., agents for India of several leading British electrical products including Jackson, E. K. Cole, Hoover, "Prestcold," Stott of Oldham, and "Silex," has been elected president of the Electrical Contractors' Association, Bombay.

Mr. J. Whitehead has been appointed works director of the Electro Mechanical Manufacturing Co., Ltd., of Scarborough. A native of Oldham, he received his electrical engineering training at the Manchester College of Technology. In 1943 he was appointed chief electrical engineer to the Stone Platt Engineering Co., Ltd., Antrim, and after some time with Platt Bros., Ltd., Oldham, he joined his present company in 1946 as general manager.

Lt.-Col. R. L. Benson, D.S.O., M.C., has retired from the board of the Automatic Telephone & Electric Co., Ltd.

Mr. A. F. Lockley, M.I.E.(India), Associate I.E.E., has recently been appointed distribution engineer to the Bombay municipal electric supply and transport undertaking. Mr. Lockley, who was previously with Callender's Cable & Construction Co. (Birmingham district), left England in 1937 to take up an appointment as assistant engineer in charge of the mains department at Bombay. In 1942 he was promoted to mains superintendent and in 1945 was also placed in charge of the public lighting department. He received his early education in Birmingham and obtained his technical training at the Handsworth Technical College and the Birmingham School of Art.

Mr. A. F. Lockley

Smiths English Clocks, Ltd., has appointed **Mr. G. Verrall** to be "Sectric" promotion manager from 1st November. Mr. Verrall has been with the company since it was formed in 1931.

Mr. D. W. Smith, B.A., F.C.W.A., has been appointed commercial manager of the British Luma Co-op. Electric Lamp Society. Mr. Smith was a student of Trinity College, Cambridge and was elected senior scholar in

physics. He specialized in nuclear physics under Lord Rutherford. During his career he has had a comprehensive experience in organizing large-scale continuous production.

Mr. L. Gardiner, formerly with George Forrest & Son, Ltd., has been appointed chief designer and manager of the architectural and special lighting department of Dernier & Hamlyn, Ltd.

The annual dinner of the **J. & P. Foremen's Association** was held at the McCleod Restaurant, Woolwich, on 27th October, 150 members and guests attending. The guests included Messrs. G. L. Wates, chairman of the company, W. Glass, joint managing director, R. W. C. Reeves, director of Johnson & Phillips, and Mr. B. Musgrave, director of the Telegraph Construction & Maintenance Co., and Dr. E. W. Smith, director of Submarine Cables, Ltd. During the speeches which followed the dinner reference was made to the seventy-fifth anniversary which the company is celebrating this year. Mr. Wates proposed the toast to the foremen.

A dinner was given by **Oldham & Son, Ltd.**, at the Park Lane Hotel on 25th October, to more than three hundred of its service station agents and distributors and friends who were attending the Motor Show. They were welcomed by Mr. E. C. Oldham, joint managing director, and Mr. S. J. Wrigglesworth, director and general manager. Other directors present were Mr. J. Hammond, Mr. E. R. Alltree and Mr. W. E. Platt. A leather-bound road atlas of the British Isles was presented to each guest. Brief speeches were made by Mr. Wrigglesworth, who presided at the dinner, and by Mr. Oldham. Responses on behalf of the service station agents were made by Mr. W. Marshall, of Bradford, and Mr. R. G. Oram, of Newquay. Following dinner there was an excellent cabaret.

A dance and buffet is being held by the **Leeds Electrical Club** on 9th November at the Parkway Hotel, Leeds. Tickets (£1 1s. each) can be obtained from Mr. M. D. Smith, hon. secretary, 10, York Place, Leeds, 1.

Over a thousand of the Long Service Association of the **Metropolitan-Vickers Electrical Co., Ltd.**, attended the annual social gathering held on 24th October at Trafford Park, Sir George E. Bailey, chairman of the company, presiding. Qualification for membership of the association is 29 years' service for men, and 26 years' service for women. The roll of 2024 includes 900 with over 35 years' service and 520 honorary (i.e. retired) members. A contingent from Attercliffe Works, Sheffield, was headed by their general manager, Mr. G. H. Fletcher, Mr. J. T. Thornhill, works manager at Motherwell, represented the Scottish factory, and Messrs. G. M. Sichel and H. W. Stainton were present on behalf of a branch now being formed in London for the Erection Department. Mr. E. W. Steele, director and general manager of works, said the directors were specially interested in the scheme under which retired members from the shop floor receive an ex gratia pension on the basis of age and length of loyal service.

OBITUARY

Mr. J. Joseph.—The death is reported of Mr. Joseph Joseph, C.B.E., M.I.E.E., at the age of seventy-six. Mr. Joseph, who was a director of Aeronautical & General Instruments, Ltd., and subsidiary companies, was educated at the Glasgow and West of Scotland Technical College and he received his training with Kelvin & White, Glasgow. From 1889 to 1913 he was technical manager of the instrument department of Johnson & Phillips, Ltd., and then was general manager of H. W. Sullivan, Ltd., until 1922. In that year he founded Radio Instruments, Ltd., which, in 1936, was acquired by Aeronautical & General Instruments, Ltd. He was general manager of the latter company from 1936 to 1946.

Mr. J. H. Haws.—The death occurred on 28th October, at the age of fifty-four, of Mr. John Hayward Haws, M.I.E.E., electrical manager of I.C.I. (Fertilisers & Synthetic Products), Ltd. Before joining the I.C.I. in 1924 Mr. Haws was with the Cleveland & Durham Electric Power Co. He was chairman of the Tees-side Sub-Centre of the I.E.E. in 1937-38.

WILLS

The Earl of Verulam, late chairman of Enfield Cables, Ltd., Enfield Rolling Mills, Ltd., Inbucon, Ltd., Sternol, Ltd. and Sterns, Ltd., who died on 29th November last, left £19,028 gross (£17,736 net).

Mr. D. M. Fraser, A.M.I.E.E., a director of the Sun Electrical Co., Ltd., who died on 14th July last, left £8,917 gross (£7,376 net).

Capt. W. Scott, founder and managing director of the Normand Electrical Co., Ltd., who died on 3rd April last, left £67,552 gross (£58,605 net).

London Board Exhibition

THE versatility of members of the staff of the London Electricity Board was shown at the Arts and Crafts Exhibition of the London Electricity Sports and Social Association, which was held on Saturday last at the Old Horticultural Hall, Vincent Square, S.W.1. The exhibition attracted a large gathering and the 1,700 exhibits included paintings, needlework, toys, models, woodwork, metalwork and photography, all of which reached a high standard. During the afternoon Mrs. Randall, who was accompanied by Mr. H. J. Randall (chairman of the London Electricity Board) presented prizes to the winners.

Electrical Contractors' Dinners

Relations with Electricity Boards

THE annual dinner of the London Branch of the Electrical Contractors' Association was held on 31st October at Grosvenor House, London, W.1, nearly 400 members and guests attending. Mr. V. J. Stock (chairman of the Branch), who presided, in proposing the toast to the Association, had a word to say about nationalization. The Association with its long experience would, with the help of manufacturers and their organizations, triumph over State monopoly. He welcomed the presence of Mr. P. G. Wallis (president of the Association) and Mr. L. C. Penwill (director), and paid tribute to the work of Mr. S. T. S. Smith (branch secretary) and Mr. A. W. D. Hawkins in arranging the function.

Mr. Wallis, in responding to the toast, said that vesting day was important in the history of the Association, first because it put them on their toes as "private enterprisers" in providing the best possible service to the public, and second, because they welcomed the elimination of the hundreds of electricity supply authorities, believing that it would lead to simplification of regulations. He referred to the proposed formation of the National Inspection Council which he said was in sight and which would have powers to strike off the register any contractor whose work was unsatisfactory.

The dinner was followed by dancing and an excellent cabaret.

Bristol Branch

The annual dinner of the Bristol Branch of the Electrical Contractors' Association was held on 3rd November at the Royal Hotel, Bristol, when Mr. S. F. Steward, chairman of the South Western Electricity Board, in proposing the toast of the Association, referred to recent reports regarding the Board's policy in affording supplies to new housing estates, and said that the rising level of prices meant that the capital costs of laying cables to a housing estate were now higher than ever before and the Board could not recover its annual charges on this expenditure out of the revenue from lighting or use of the radio only. It was therefore compelled to ask local authorities to make sufficient provision in the houses for the use of electricity so that the tenants could use electric cookers and water heaters if they so wished. Alternatively, the Board had to ask local authorities to pay a contribution towards the cost of laying the cables. If the houses were not provided with power points there was no real freedom of choice for the consumer.

The equipping of the ground floor of the building planned and built by Bristol Corporation for its Electricity Department, which was taken over on vesting date, was now nearing completion, and the Lord Mayor of Bristol would officially open the new Service Centre on 29th November. The Board would be happy to give private contractors the opportunity of staging at some time in the future their own collective exhibition in this building.

Mr. P. G. Wallis, president of the Association, in responding, pleaded for some form of standardized wiring practice.

E.C.A. of Scotland

State electrical monopoly, freed from competitors or creditors, must be expected to "produce the goods" in the shape of cheap electricity, declared the Earl of Selkirk when he proposed the toast of the Association at the jubilee diner of the Electrical Contractors' Association of Scotland at Grosvenor Restaurant, Glasgow, on 2nd November. Mr. R. Smith, Edinburgh, the president, who replied, paid tribute to the founders and early office-bearers of the Association. Mr. J. B. Mackenzie, past president, proposed the City of Glasgow, Bailie T. R. Patterson responding. The toast of the guests, given by Mr. D. D. Shaw, immediate past-president, was acknowledged by Mr. A. S. Black, and Major J. L. Drummond proposed the chairman.

Electricity Supply Tables

THE 1950–51 edition of the "*Electrician* Annual Tables of Electricity Undertakings of the World" has been published by Benn Brothers, Ltd., Bouverie House, 154, Fleet Street, London, E.C.4, at 30s, including postage.

This, the 60th, edition is a complete revision of the tables available last year and contains, in addition to the customary information given under place names, data of systems of supply, tariffs, frequencies, etc., in a large number of towns both at home and abroad not hitherto available.

Statistics appropriate to Great Britain and Northern Ireland are presented in a new form and a "Who's Who in the B.E.A." is included. The towns and cities, especially those in the "foreign undertakings" section, are far greater in number than in previous years and details of supply services operating within them are arranged in such a way as to facilitate reference.

VIEWS on the NEWS

By REFLECTOR

MR. George Bernard Shaw, who died at the age of 94 last week, had at least two points of contact with the electrical industry during his long and varied career. Soon after his arrival in London from Dublin in 1879, he obtained a job in the wayleave department of the Edison Telephone Co. In this he is said by Hesketh Pearson in his "Bernard Shaw" to have enjoyed the exploration while hating the interviewing. He left when the Edison concern was merged in the National Telephone Co. Later on, at the beginning of the century, he was elected to the St. Pancras Borough Council and served on the Electric Lighting Committee.

* * *

Shaw himself in the preface to his novel "The Irrational Knot" said :—

> "As I was interested in physics and had read Tyndall and Helmholtz, besides having learnt something in Ireland through a friendship with one of Mr. Graham Bell's cousins, who was also a chemist and a physicist, I was, I believe, the only person in the entire establishment who knew the current scientific explanation of telephony; and as I soon struck up a friendship with our official lecturer, a Colchester man, whose strong point was pre-scientific agriculture, I often discharged his duties for him in a manner which, I am persuaded, laid the foundation of Mr. Edison's London reputation."

* * *

As a matter of interest, I have been shown a letter by the editor of the "Electrical Who's Who." The writer contends that the initials "D.L.C.," which are defined in the list of abbreviations in that publication as "Diploma Loughborough College," are properly applicable to "Doctor of Celtic Literature." I must admit that this was new to me but it certainly appears this way in "Whitaker's Almanack" which the writer quotes as his authority. On the other hand "Who's Who" (the general not the electrical one) allots the initials to Loughborough College. In any event I should say that the number of Doctors of Celtic Literature in the electrical profession and industry can be counted on the fingers of half a hand, whereas quite a number of electrical people graduated from Loughborough.

* * *

When I wrote last week of my inability to recommend a left-handed heat controlled iron I had a feeling that the ingenuity of British home appliance design engineers must have designed some apparatus which was equally suitable for either left- or right-handed users. I am now reminded that the Hotpoint "Plus Five" iron has a double thumb rest, a double button nook and a patented automatic swivel flex connector which allows an unrestricted movement on both sides without kinking. Actually this iron was designed and marketed before the war and, though supplies are at present limited, it is still available.

* * *

From a reader in Burma I have received the following extract from a letter sent by a prospective consumer :—

> "I have already filled up the form in respect of testing inner-wire installation of my house on 6-7-1950. The inner wire of my house has been installed by my son before he left for United Kingdom and he is now serving in the H.M.S. Infatigable (Home guard of England) as Midshipman (Engineer). Hence there would be no mistake in installation of wire in my house."

* * *

A correspondent writing to the *Evening News* comments that thirteen men visited his house in two days to take out his gas stove and install an electric one, and another employee was due to call to collect a meter. This certainly seems to be a bit lavish. The writer, however, does not say how many were gas and how many electricity employees. Perhaps they included a deputation from the Gas Board to persuade him that the change was to be deplored?

Fluorescent-Tungsten Lighting

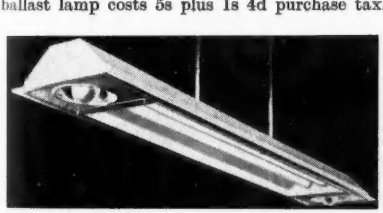
Elimination of Accessories

AN interesting development in lighting which has just been announced by Philips Electrical, Ltd., is an instant-self-start 4ft 40 W fluorescent lamp, for operation in series with a special tungsten ballast lamp which also functions as an efficient source of light. The two lamps in series form a complete circuit rated at about 113 W on 230 V a.c. mains. Chokes, transformers, capacitors and starters are all eliminated.

Other advantages of this system are an overall initial (100 hour) luminous efficiency of about 22 lumens/W (about double that of a tungsten lamp), a pleasing blend of fluorescent and tungsten light in a single fitting, an inherent power factor of 0·97 without correction, and long average life of the lamps.

The company has also introduced an initial range of four fittings for commercial, domestic and industrial lighting, each accommodating two fluorescent tubes and two ballast lamps.

The 4ft 40 W instant-self-start fluorescent tube is available in " mellow " or " natural " colour at 17s plus 4s 5d purchase tax, while the ballast lamp costs 5s plus 1s 4d purchase tax.

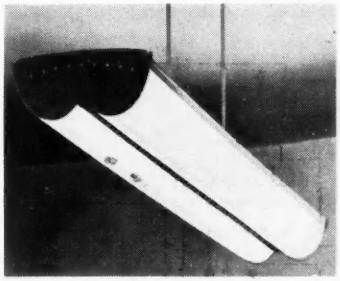


Philips fitting incorporating two instant-self-start tubes and two ballast lamps

These lamps are for use together on 220/230 V or 240/250 V a.c. mains only. The fluorescent lamp has a special single contact cap and must not be used in inductive ballast circuits. The lampholders are available as separate components. The ballast lamp has a three pin bayonet cap of standard form and requires a three-slot bayonet lampholder.

G.E.C. Equipment

In a new circuit for fluorescent lighting introduced by the General Electric Co., Ltd., the usual choke, starter and power factor capacitor are dispensed with. A tungsten ballast lamp serves the same current stabilizing purpose as a choke and a small filament heating transformer



G.E.C. two-lamp decorative fitting incorporating the new tungsten lamp control system for fluorescent lighting

gives instant starting. As no choke is used, the power factor approaches unity and no capacitor is required. Apart from this the ballast lamp emits useful light, which, when blended with the fluorescent light, produces illumination of a very pleasing quality.

The fitting designed for use with the new circuit is of attractive appearance and incorporates two standard 4ft 40 W " Osram " fluorescent lamps.

The heating current supplied by the transformer and the use of 4ft lamps with earthing strips combine to ensure starting without a preliminary stepping up of voltage on 220/250 V mains. If the fitting is to be used on 200/210 V mains the transformer can be modified to give a slightly higher voltage across the lamps at starting.

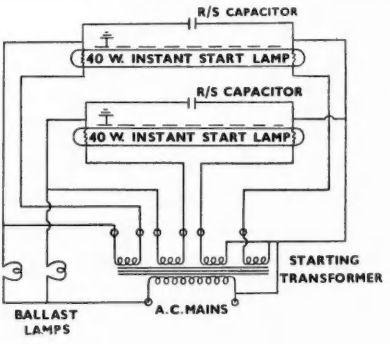
Three types of ballast lamp cover the voltage range 220/250 V. They operate at about 65 W each and have a life comparable with that of the fluorescent lamps in normal conditions. The overall consumption of the fitting on 240 V mains is about 210 W and the average overall light output of the combination, using " mellow " lamps, is about 4,000 lumens. Although the " mellow " colour will probably be the most popular, the average light output can, if desired, be raised to about 4,700 lumens by using " daylight " lamps.

B.T.H. System

The British Thomson-Houston Co., Ltd., has also introduced a similar instant start fluorescent lighting unit with a lower initial cost than would be possible with standard lamp auxiliary gear. In place of the conventional choke,

starter, and p.f. correction capacitor a special "Mazda" tungsten lamp and a filament heating transformer are introduced into the circuit, the transformer supplying a small steady current to the cathodes to facilitate striking of the fluorescent lamp. The tungsten lamp ballast, which is rated at about 60 W, itself gives light which blends with the light from the fluorescent lamp.

This circuit is readily applicable to a combination of two fluorescent lamps and two



"Mazda" instant start fluorescent lamp circuit with tungsten lamp ballast

tungsten lamp ballasts, with one filament heating transformer supplying the four cathodes (see diagram). Standard "Mazda" instant start 40 W tubes are used but the tungsten ballast lamps are specially designed for the purpose; they have non-standard ratings and are therefore fitted with 3-pin bayonet caps to avoid confusion with standard lamps. In this circuit the efficiency of the combined light output is about 20 lumens/watt and the overall consumption about 200 W varying somewhat with applied voltage.

This type of circuit will be suitable for 200/250 V mains, but at present, equipment is available for the 220/250 V range only. Work is proceeding to extend the application to 200/210 V supplies as soon as possible.

Glass Manufacture

WE have received from the General Electric Co., Ltd., a copy of an excellently produced and illustrated 48-page brochure which describes the activities and products of the Osram-G.E.C. glass works at Wembley. After a brief introduction outlining the growth of the organization the various products are described together with the special techniques and machinery employed in their manufacture. The range of products includes bulbs for lamp making; tubing—soda, lead and neutral; pressings for cathode ray tubes and illuminating ware; and glass to metal seals. The properties of the various grades of glasses made are then enumerated, after which consideration is given to technical control in glass manufacture and in the examination and selection of finished products. The booklet concludes with a short chapter on annealing. There is also a useful appendix quoting the approximate number of ft per lb of the range of machine and hand drawn glass tubing and rod.

Better Housekeeping

A CALL to housewives to change their old stoves for modern electric cookers on hire purchase for "a few coppers a day" was the principal theme of the North Western Electricity Board's stands at the Better Housekeeping Exhibition held in the City Hall, Manchester, from 17th to 28th October.

The Board furnished two stands, both tastefully decorated in white, lemon, chocolate and pale blue. The main stand concentrated on cooking and water heating, and had an attractive "window" focusing attention on the cooker by means of exhibits, an animated book and a set piece illustrating the "few coppers" as cartooned policemen. The other was an "overflow" stand displaying various types of domestic appliances. At this stand, also, visitors were able to witness the continuous projection of films dealing with electrical domestic subjects. Board personnel officiated at Ministry of Food cookery demonstrations given regularly throughout the exhibition.

Henley Education Scheme

THIS year's conversazione in connection with the education scheme of the Henley Organization was held at Gravesend Technical College last Saturday. Dr. P. Dunsheath, C.B.E., director and consulting engineer, Henley's, and chairman of the scheme, presided and Sir Montague Hughman, chairman of the Henley Organization, presented almost 100 awards to students. There was an exhibition of handicrafts and art which, together with demonstrations, was arranged by Messrs. H. C. Hoban, F. A. Ponder and A. S. Brewer. Prizes in this section and a new challenge trophy were presented by Mr. S. E. Goodall, Henley's chief engineer and deputy-chairman of the Education Committee.

During the afternoon an address was given by Sir Wilfrid Garrett, formerly Chief Inspector of Factories, and he was thanked by Mr. P. M. Pennell on behalf of the students.

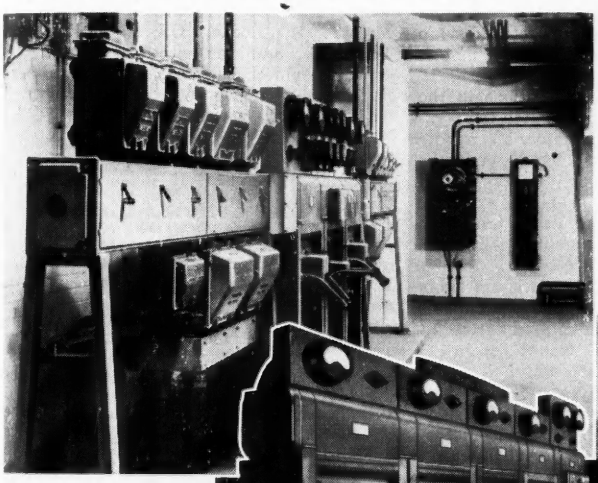
Leeds University

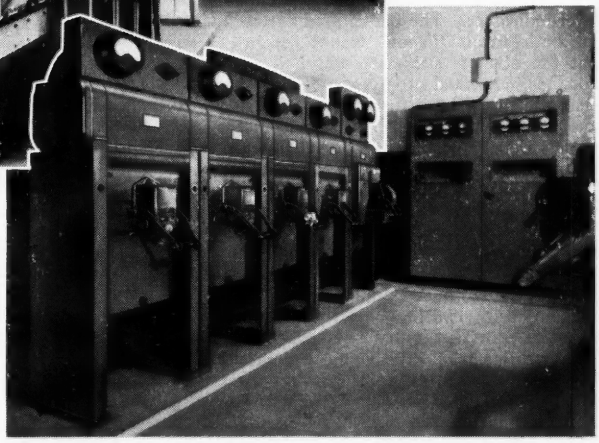
Electrical Equipment of New Extension

ALTHOUGH the main structure was nearing completion in 1939 at the outbreak of the war, the new extension to Leeds University erected as a result of a bequest by the late Mr. Frank Parkinson, chairman of Crompton Parkinson, Ltd., has only just been equipped for its original purpose. During the war it served as a grain store for the Ministry of Food. The new building now provides the main entrance to the University and besides providing additional lecture rooms for the study of the arts, languages, etc., also includes administrative offices and a large entrance court.

Electrical interest in the building centres largely on the lighting, of which about 100 kW has been installed, but in addition there are approximately 60 h.p. of electric motors, together with about two hundred 13 A socket outlets, arranged on a ring main system, for portable appliances. Altogether the maximum demand is around 750 kVA.

At a central feeding point to serve both the old and new buildings provision is made for an ultimate load of 1,200 kVA. In the basement of the old building a 415 V 3-phase supply from the Yorkshire Electricity Board is brought via two 1·0 sq in feeders to two 600 A "Klad A" main incoming switches whence 0·3 sq in cables are taken to 300 A "Klad A" switches with bus interconnection feeding the North and South sections of the building. Facilities are provided for metering the supply to each section separately. To provide space for the cable ducts a high level floor has been superimposed on the original floor. Rising mains are carried through trunking to the triple pole and neutral fuseboards throughout the





Above: L.v. switchboard (English Electric) and master clock with programme ringer. Right: Crompton Parkinson "Klad A" h.v. switchgear

building, all the conduit being concealed in the floors.

Also located in the basement is plenum air conditioning, hot water radiator heating and ventilation plant comprising circulating, condensate return and sump pumps, motorized mixing valves and fans. The whole of the plenum system, which serves the lecture rooms and Council Chamber, is automatically controlled by wet and dry bulb thermometers and dampers operated by remote control by means of motorized valves. Cold air is admitted at roof level and provision is made for mixing atmosphere and re-circulated air. The main 4ft diameter fan for the plenum system is driven by a 7½ h.p. motor. In addition to a general extract fan driven by a 5 h.p. variable speed motor there are separate extract fans, also with variable speed motors, serving the lecture rooms (4 h.p.) and Council Chamber (1 h.p.). A 4 h.p. motor driven pump is used for circulating the water of the hot water radiator system, a 2 h.p. pump feeding the plenum system. For the condensate return, sump pump and hot water supply h.p. motors are employed.

Air temperatures in ten positions in the building are indicated on a remote temperature recorder and all the motors are remote controlled, visual signals being given in the boiler house and the respective floors as well as on the remote control panel. If excessive high or low levels in the water tanks are reached, both visible and audible alarms are given at the main control position.

Two passenger lifts serving the six floors (lower ground to fourth) have luminous level indicators. The South lift is arranged for both automatic and manual operation but the other is automatic only. The top floor is allocated to Modern Language Departments, the others respectively to lecture rooms; the Phonetics and Mathematics Departments; the Council Chamber, committee rooms and administrative offices; Central Court and general offices; and cloakrooms, calorifier and switch rooms, etc.

Interesting features of the lecture rooms are the motorized blinds for shutting out the light when using film or lantern slide projectors, and motorized dimmers giving from full to zero lighting. For examination purposes provision is made for plug-in type transportable telephones giving communication with a central point via a private manually operated exchange. A combination of tungsten and fluorescent lighting is used throughout the lecture rooms, special fittings being provided to illuminate the blackboards. Sound-proof rooms for the Phonetics Department are equipped with both disc and wire recorders and have signalling devices to indicate when they are in use.

In addition to concealed cornice lighting from 170 60 W tungsten lamps, the walnut panelled Council Chamber has a laylight accommodating five 500 W lamps and two massive chandeliers each taking 500 W of lamps. Nineteen chandeliers of similar type are used in the Central Court, provision being made for raising and lowering them by means of a winch.

A conduit system has been installed throughout the Centre Court for a public address system. An electric impulse clock drives fifty slave dials and is fitted with a programme ringer. The turret clock in the tower is also controlled by the master impulse clock.

The architect of the new building was Mr. T. A. Lodge, O.B.E., F.R.I.B.A., F.R.I.C.S., and the electrical contractors were Troughton & Young, Ltd.; J. Stinton Jones & Partners were the consultants. The photographs reproduced were supplied by the University photographer.

Die Cast Conduit Fittings

AN illustrated booklet has just been issued by the Zinc Alloy Die Casters' Association (Z.A.D.C.A.) entitled "The Durability of Zinc Alloy Die Cast Conduit Fittings." Much of the information it contains has resulted from special investigations and laboratory corrosion tests carried out on behalf of the Association. The text includes recommendations for providing additional protection when fittings are exposed to particularly corrosive conditions, and is illustrated by examples chosen from the many commercially available fittings.

Emphasis is laid on two essential points, viz: the zinc alloy used must comply with B.S.1004A, and careful attention must be paid to design. Like the unalloyed zinc used for protecting galvanized steel conduit, zinc alloy die castings resist atmospheric attack about ten times as well as mild steel. When due attention has been paid to these two essential points, the vast numbers of conduit fittings which have been in use for many years have given excellent service.

Copies of the booklet are available free on request to Z.A.D.C.A. at Lincoln House, Turl Street, Oxford.

Educating and Training Technicians

Report Discussed at I.E.E.

Sir Arthur Fleming

AT a meeting of the Institution of Electrical Engineers in London last week Sir Arthur P. M. Fleming, C.B.E., D.Eng., introduced for discussion a report entitled " The Education and Training of Electrical Technicians " which has just been published by the I.E.E., price 1s, post free. This report has been prepared by the Joint Committee on Practical Training in the Electrical Engineering Industry of which Sir Arthur Fleming is chairman, and which comprises representatives of the Council of the British Electrical and Allied Manufacturers' Association, the Radio Industry Council, and the Council of the Institution of Electrical Engineers.

Present Facilities Inadequate

In the course of its study of the problem of educating and training these technicians the Joint Committee has carefully reviewed existing facilities and this has revealed two main facts. Firstly, the status of electrical technicians is not nearly so well-defined, nor the importance of their systematic training so fully appreciated, as is the case with professional electrical engineers or craftsmen. Secondly, the facilities for educating and training them are quite inadequate in quantity and extent.

No attempt has been made to prescribe in detail either the training of the different types of technicians in the electrical industry, or the courses of education that should be available for them. Attention is concentrated on the underlying principles on which courses of education and schemes of training should be planned. The principal method of providing for these needs should be a four- or five-year apprenticeship or training (the period depending on the standard of entry), with concurrent education at a technical college. An alternative method is the " works-based " sandwich scheme which may be particularly appropriate where a number of firms can join together to provide adequate training in a co-operative scheme which they would be unable to do individually. Special attention is drawn to the practical aspects of training as being of vital importance.

It is recommended that electrical technicians should have a basic course of education up to Ordinary National Certificate standard, and that, subsequently, most of them will benefit by specialized courses. Stress is laid on the need to make provision for craftsmen who show promise, to transfer to training as technicians, and also for suitable technicians in training to transfer to student apprenticeships. The Joint Committee also recommends the proper supervision of apprentices and the need to appoint an officer whom apprentices can always approach for personal guidance.

Recognized Courses Needed

The discussion was opened by Sir John Hacking (B.E.A.), who said that some electrical technicians rose from the craftsmen grades, but the majority started out with the idea of becoming professional electrical engineers, and at some stage, just failed to make the grade. They were often very sound practical men, and acquired such a knowledge of their particular field that in many respects they might equal the professional engineer. It would be unfortunate if technicians continued to be recruited in this unsatisfactory way ; it was high time that recognized courses of training were provided to enable them to discharge their responsibilities.

Colonel B. H. Leeson (director, B.E.A.M.A.) suggested that the fact that the electrical industry now employed about half a million people and stood pre-eminent in the world was a tribute to the training already carried out, but that did not mean more was not required. The report was a challenge to

firms, other employers and educational authorities to co-operate to bring this about. In the larger firms a great deal was already being done, but provision was required for men in the smaller firms.

Vice-Admiral Dorling (director, Radio Industry Council) said the education and training of technicians was of vital importance to the radio industry. It could not carry on without the help of technicians and would welcome further opportunities of suggesting the types of specialized course which should be envisaged.

Opportunities for Advancement

Mr. H. J. Shelley (Ministry of Education) felt that there was a tendency in the report to draw the line a little too much in terms of academic training and qualifications, while the great strength of engineering training in this country lay in the better opportunities for vertical mobility for all personnel as compared with the situation on the Continent. It was easy in such reports to forget the individual student, but it was the job of education to think of the individual and help him to develop his capacities to the full, while it was for industry to give him the fullest opportunity to make use of his abilities.

Mr. W. F. Parker (vice-chairman, Association of Supervising Electrical Engineers) was concerned to find that the report assumed that every young man before starting on an electrical career must decide whether to be a craftsman, a technician or a professional engineer. Encouragement should be given to schemes in large organizations which provided a common course for all grades in the early stages up to the Ordinary National Certificate standard, and support should be given to a national scheme to provide for the personnel of small organizations, which should provide a continuous course for all grades from the craft apprentice to the professional engineer.

Principal Reid (S.E. London Technical College) deplored the suggestion of week-end courses at technical colleges, and thought there would be difficulty in providing laboratory work for students who were taking correspondence courses. He had no doubt, however, that those concerned with technical education would co-operate with industry in producing a satisfactory scheme.

Mr. N. G. Treloar (B.I.C.C.) thought it would be a pity to adopt the suggestion that electrical technicians attending a National Certificate course should have some relaxation in mathematics ; it would be undesirable to have two grades of National Certificate. If the technicians were to have an association of their own he thought it should help them to lean towards the management rather than the trade union outlook, and suggested there should be a link with the Students' Sections of the I.E.E.

Dr. K. R. Sturley (B.B.C.) said the report was fully confirmed by his own experience during the past five years in training such men. The basic courses should be operated by the technical colleges, but the specialist courses must be the responsibility of industry.

Mr. R. A. Marryat (Marryat and Place, Ltd.) said his firm had trained technicians and craftsmen jointly under an apprenticeship scheme for over 25 years. They felt that the technicians must have practical experience of the job from the bottom upwards. Sandwich courses of three to five weeks at the polytechnic and then eight or ten weeks with the firm were of great advantage when boys were away from home and could not attend evening classes.

Dr. Raymond Whitehead (Manchester University), speaking as a doctor of medicine, said that in medicine the problems involved seemed similar to those in the electrical engineering profession. The National Health Service depended on the work of laboratory technicians, who had an association of their own and a well-developed corporate spirit. It was important that there should be such associations, and that they should be connected with the professional institution concerned.

Mistaken Policy

Mr. G. A. Taylor (Philips Electrical) said it was even more important at the present time to pay attention to the education and training of technicians than that of professional engineers. In large organizations there was a tendency to repair the deficiencies in the education and training of technicians by bringing in a heavier concentration of professional engineers, but he believed this to be a mistaken policy. Modifications to the Ordinary National Certificate were overdue, with particular reference to the greater cleavage between the light and heavy current sides. He deplored the suggestion that the mathematical standard might be reduced.

Mr. A. Brammer (secretary, Association of Supervising Electrical Engineers) emphasized

the educational work which his Association had been doing for many years, and, referring to the suggestion that some organization of technicians should be formed, recommended that the Institution should give consideration to an organization which was already well-established and respected in the industry.

Colonel B. H. Leeson, referring to the suggestion that an association of technicians should be formed, said that in his view the report envisaged not one association but a number, in order to cover the whole field. The Institution (of which Col. Leeson is a vice-president) was considering the question very carefully, and had set up a committee to consider whether it could help in the formation of such associations.

Mr. G. F. Freeman (West Ham Technical College) expressed some disappointment with what Colonel Leeson had said, which seemed to him like "shedding the load." He thought that the Institution should take a more active part. They all had their sectional interests, and much of the matter in the *Journal* concerned other branches of the profession.

Mr. L. W. Phillips regretted that no respresentatives of those classed as technicians or of those likely to be engaged in teaching were on the Committee, which was overweighted on the academic and management sides.

Mr. M. W. Humphrey Davies suggested that some means should be provided to encourage the man who obtained an Ordinary National Certificate but did not feel that he could tackle the higher certificate course, or the man who had come up by means of a craft course and did not want to go through the labour of getting an Ordinary National Certificate. He had in mind something like an external examination operated by the City and Guilds Institute which could be taken after two years of not very arduous study.

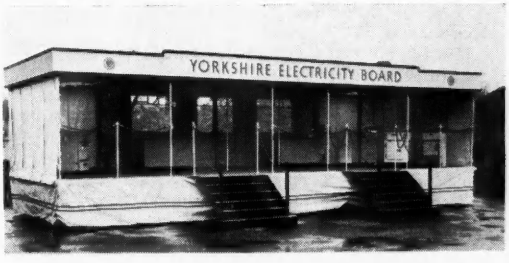
Mr. Platt (Brush Electrical Engineering Co.) said he was not happy about the report as a guide for action at present. It implied that there should be a fourth group of apprentices, to be called technician apprentices, and this seemed neither wise nor necessary.

Captain J. Legg said it was impossible to attempt to fill technicians' jobs by those who had started out to be professional engineers and had failed to make the grade. It was also impossible to fill them by having too rigid a scheme of training. There must be great flexibility in the application of the report.

Mr. I. O. Hockmeyer described what was being done in the R.A.F. in regard to the training of technicians, and Sir Arthur Fleming briefly replied to the discussion.

Exhibition Trailer Unit

THE Yorkshire Electricity Board recently commissioned a new exhibition trailer unit. This will be used as a mobile stand at agricultural shows, as a display vehicle in market places and, on occasions, for film shows and demonstrations. The trailer is built on a Tasker's 6-ton low loading chassis and is towed by an ordinary covered lorry which carries the necessary equipment. This vehicle can be used simply as a demonstration caravan, or alternatively, one long side can be opened, roof sections attached, and canvas curtains fitted, to double the floor area. If the two ends are opened up, and ceiling and corner sections are added, the complete floor space can be extended to 38ft by 14ft. A permanent electrical installation provides numerous supply points for the exhibits. The canvas and all the smaller auxiliaries are contained in a large covered compartment underneath the chassis. The facias, and the spare floor and roof sections are carried in the towing vehicle. At the first trial four men erected the unit, less exhibits, in under two hours from the arrival on site.



Yorkshire Electricity Board's new exhibition trailer unit

Cable Ratings

Permissible Short Circuit Temperatures

THE question of the maximum currents that cables are capable of carrying under short circuit conditions has assumed much greater importance in recent years on account of the general development of bulk supply and the enormous power now available from the grid. The present-day values of cable short circuit ratings, recommended and published by the C.M.A. in 1937, limit the maximum conductor temperature during the period of short circuit to 120 deg C. These early standards appear to have provided a good margin of safety, but there is a feeling in some quarters that they are conservative for modern requirements. In particular they often necessitate the use, even where the power demand is relatively small, of large and uneconomical sizes of conductor, solely to provide the requisite short circuit capacity.

Results of Experiments

The Cable Makers' Association says that the whole subject has been under review for some time past and investigations of the nature of the effects produced by heavy short circuit currents in cables have been in progress. Experiments on sample lengths have indicated that there is no apparent deterioration of the insulation, even at conductor temperatures approaching 300 deg C, for short circuit durations up to one second. It may be dangerous however to have a high limit for the maximum conductor temperature should the short circuit, by any chance, be sustained, owing perhaps to automatic reclosing of a circuit breaker or tardy operation of the trip gear. In the event of any prolongation of the time period of the short circuit, the increased temperature would result in the destruction of the cable insulation.

Attention must also be drawn to the fact that, in the case of phase-to-earth faults, the lead sheath will not in most cases carry the same short circuit current as the conductors without the temperature reaching a dangerously high value.

Quite apart from such possibilities the maximum conductor temperature must be restricted so as to safeguard the behaviour of the cable joints under short circuit conditions. The solder used in jointing softens at 180 deg C and if the temperature of a conductor joint exceeds this critical value the solder will tend to run out. The limiting temperature must then be dependent upon the solder itself, and in this respect the tensile strength of the soldered joint is much reduced at temperatures well below the critical value. This must be considered in conjunction with the fact that severe strains may result from thermal expansion and contraction effects which occur in the cable and accessories if the conductor reaches too high a temperature.

The above considerations, however, only deal with the thermal aspects of possible damage to a cable installation in operation in service under heavy short circuit. A further aspect is that of the mechanical forces produced within the cable. The large magnetic forces set up between adjacent conductors tend to disrupt the internal structure of the cable. On this account there will be a definite limit to the maximum permissible short circuit current, quite irrespective of any time/temperature relation. Owing to this fact the ratings for the shortest time-to-break periods may be dependent upon the mechanical stress factor, particularly in the case of large conductor cables.

All the above aspects are now under active investigation by the Electrical Research Association and until final results are available the Cable Makers' Association considers it inadvisable to permit a maximum conductor temperature exceeding 120 deg C at any time.

Trotter-Paterson Lecture

THE Illuminating Engineering Society has announced that the first Trotter-Paterson Memorial Lecture is to be given at the Royal Institution, Albemarle Street, London, W.1, at 6 p.m. on Wednesday, 17th January. The lecture is to be given by Dr. J. W. T. Walsh of the National Physical Laboratory and will be entitled "The Early Years of Illuminating Engineering in Great Britain." The lecture is open to the public, admission being by ticket only, which can be obtained on application to the Secretary, Illuminating Engineering Society, 32, Victoria Street, London, S.W.1.

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Motor Design Courses

WITH reference to this correspondence the Acton Technical College is running an electrical machine design course for endorsement of the Higher National Certificate. Although this course does not specialize in fractional horse power design, it may be of some use to Mr. E. O. Muller who could, if he wished, obtain a syllabus from the college.

I, myself, have found plenty of American books dealing with various aspects of the work, but have so far located very little dealing with British practice. Perhaps Mr. E. H. Werninck or some other of your readers, may be able to help me in this direction.

Stanmore, Middx. A.D.H.

MR. E. O. MULLER is setting about his career in the wrong way if he proposes to study the electrical design of f.h.p. motors as distinct from the design of larger machines. While he may be inclined to specialize in small machines as a career, he would be doing himself and the industry a disservice were he to attempt to so specialize in his education.

The practical design of all electrical machines is based on the work of such men as Miles Walker, Hawkins, Wallis, Say and Clayton and the principles laid down by these men are taught at many institutions in the South London area. Possibly the most convenient for Mr. Muller is the S.E. London Technical School at Lewisham.

All practical design tends to be somewhat empirical, or one might say that the practical event has not yet been closely related to a given theoretical principle, and in this respect the design of f.h.p. machines is not more intricate than the design of, say, turbo-alternators. It is true, however, that more has been published about the problems of the larger machines. Most textbooks on small machines tend to be little more than electricians' handbooks. However, this does not alter the fact that a squirrel cage induction motor behaves in accordance with certain principles whether its output is measurable in terms of kilogram-metres or ounce-inches. It follows therefore that, with certain reservations, its design can be carried out on established lines.

Finally I would implore Mr. Muller not to be perturbed by the fact that Miles Walker in his monumental "Specification and Design" treats a 35 h.p. motor as a small machine.

Clifton, Bristol, 8. E. P. McCORMACK.

Discounts for Contractors

I WOULD like to draw attention to two points in article No. 14 in the series "Electrical Contracting: Organization and Routine," by H. R. Taunton, which appeared in your issue of 27th October, viz. :—

> (1) The question is posed "Is it fair trading on the part of the maker to offer a buyer terms better than he would allow the wholesaler to give?"
>
> (2) A statement is made that "contractors have learnt from experience that many makers, driven by competition, will give them for a good order something better than their usual quantity terms."

With regard to the question in (1) the answer is, indisputably: "No, it is not fair trading."

The inference in (2) that many manufacturers' terms are very elastic, allowing a substantial order to be recognized by discounts in excess of their established quantity terms, is very misleading. It is therefore pointed out that, although under the provisions of the Fair Trading Policy the scales of any quantity terms to be made available are entirely at the discretion of the manufacturer, once they are established he is morally obliged to observe and not exceed such terms in dealing direct with the trade and other customers. Likewise, where his products are distributed through wholesale channels, a wholesaler is automatically entitled to grant the same scale of quantity discounts as the manufacturer allows, but he must not exceed those terms.

Everything that appears in the Fair Trading Policy is there by consent of the industry and it is therefore most unlikely that the members of manufacturing member-

associations represented on the Fair Trading Council would indulge in the practice referred to by Mr. Taunton. Indeed, if otherwise, it would be a contradiction of the principles enunciated in the Policy and would mean that commercial integrity was lacking on the part of the known supporters of the Policy.

There are, of course, a large number of manufacturers not represented on the Council and perhaps it is amongst such that this malpractice exists. Generally speaking, however, the "non-associated" manufacturers follow and support the Fair Trading Policy, in appreciation of the fact that its trading structure and principles represent a commonsense, orderly and the fairest way of conducting their own trading.

ARTHUR S. LOWE,
London, W.C.2. *Secretary,*
Electrical Fair Trading Council.

I CANNOT agree with H. R. Taunton (*Electrical Review*, 27th October) that many makers, driven by competition, will allow contractors something better than their usual quantity terms when given a good order. If such a practice were general I should be one of the first to hear about it, but, in fact, I have very few complaints of this kind. Nor can I agree with the reasoning behind the statement that when contractors want special material which they know the wholesaler cannot be expected to stock they will be wasting their time by placing the order with the wholesaler.

The true position is that the contractor might save time, because he would have a current account with his wholesaler and in all probability not with the particular manufacturer whose products are called for. If several items were required the contractor would save money, as well as time, by ordering through his wholesaler because of postal and bank charges. Finally, it is highly probable that if the wholesaler is in the contractor's locality he will also save carriage charges.

Though I appreciate the writer's support for the wholesaler, I think these two points should be taken care of.

A. B. WILDSMITH,
London, W.C.2. *Director.*
Electrical Wholesalers' Federation.

Electricity Reserve Funds

IN the House of Commons on 1st November Lord John Hope raised the question of the disposal of the general reserve funds of former local authority electricity undertakings in the South-East Scotland Area. These funds, he said, which included more than £1 million of investments and cash, were vested under the Electricity Act, 1947, in the British Electricity Authority. The South-East Scotland Area Board claimed that, on principle, credit for such reserves should be given to the Boards in whose areas they were originally formed. So far, after many months of correspondence, the Minister of Fuel and Power had refused to intervene in favour of the Board's claim, although the Act explicitly gave him the right of intervention.

What he would like the Minister to do was to direct that the Central Authority, while retaining ownership of these general reserve funds, should give credit to the Area Boards which surrendered them by an appropriate writing down of the value of the assets on which these Boards paid interest and depreciation.

Mr. Hoy (Labour) appealed to the Minister to reconsider his decision. These funds, which accumulated under the prudent management of the old Authority, were in fact set aside for the benefit of the people under a scheme of municipal Socialism. They were accumulated for the benefit of the consumers in the Edinburgh area and had been taken from them with no real compensation for the loss. In other areas debts were accumulated and, to a very large extent, these debts had been taken over by the Central Authority.

Mr. Robens, Parliamentary Secretary to the Ministry of Fuel and Power, in reply, said that they could not really deal with the reserves of the Edinburgh Corporation in isolation from those of any other local authority. If there were to be any change at all in the treatment of these reserves it would have to be on general lines throughout the whole of the country. The suggestion that the Area Boards should take over all the assets and be responsible for all the liabilities in their areas would not be nationalization: it would be regionalization, and the Act was passed to nationalize the industry.

British Plant for Ontario

ACCORDING to a special Toronto correspondent of the Manchester *Daily Dispatch*, the Hydro-Electric Power Commission of Ontario has placed an order for two further turbines with C. A. Parsons & Co., Ltd., at a total cost of £6 million.

Commerce and Industry

Large Diesel-Electric Locomotive Contract

Royal Tour of Welsh Factories

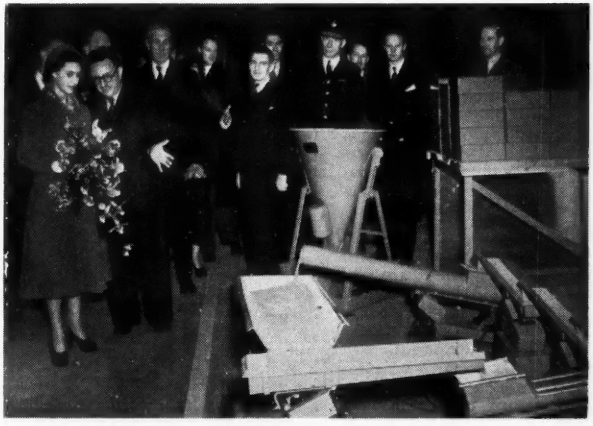
THE Western Australian Government has placed an order with the Metropolitan-Vickers Electrical Co., Ltd., for 48 diesel-electric main line locomotives valued at £2,250,000. This is claimed to be the largest order for diesel-electric traction equipment ever placed with a British firm. The locomotives are to be of rigid frame design and of the 4-8-4 type. They will have four driving axles in the main frame and two two-axle carrying and guiding bogies to meet the low axle-loading requirements. Each locomotive will be fitted with a Crossley two-stroke loop-scavenge engine primarily designed for traction applications: the service rating under Australian climatic conditions will be 1,100 b.h.p. The traction motors, generators and auxiliary machines will be manufactured at Metropolitan-Vickers' Attercliffe Common Works, Sheffield, and the remaining electrical equipment at the company's Trafford Park Works. The manufacture of the mechanical parts and the final assembly (and also of the 40 Metrovick locomotives ordered recently by the N.S.W. Government Railways) will be the responsibility of Metropolitan-Vickers–Beyer, Peacock, Ltd., Stockton-on-Tees.

Stepney Wiring Contract

For the first time within the memory of councillors, Stepney Council is putting out a contract for electrical installation work for a housing scheme to a private firm. Previously the work was always given to the Stepney electricity undertaking which on nationalization was taken over by the London Electricity Board. Last week the Finance Committee recommended that the work should go to a private firm and this was approved. Councillor J. O'Connor, opposing the recommendation, said the work was being given to a private firm to save £100. When they had their own electricity undertaking they had fought for many improvements in the men's conditions and the London Electricity Board, on taking over Stepney's undertaking, had continued all these improvements. Councillor W. Humphries considered that the nationalized industries must be made to pay or they would not be run in the best interests of the people. Councillor J. Lawder, leader of the Council, said that if the London Electricity Board was to do work for them in the future it must give them better service than it had in the past.

Princess Margaret Visits Wales

Princess Margaret performed the opening ceremony of the extensions of the Blackwood Works (Monmouthshire), of South Wales Switchgear, Ltd., on 2nd November. The area of the extension is approximately 40,000 sq ft and the present premises at Treforest and Blackwood now total approximately 150,000 sq ft. Princess Margaret saw in production 11 kV switchgear and transformers for Pakistan which form part of the £500,000 contract recently received by Aberdare Cables, Ltd., and South Wales Switchgear, Ltd. Although the contract was placed only five months ago, the first shipment of cables, power transformers



Princess Margaret touring the Blackwood factory of South Wales Switchgear, Ltd., after opening an extension there

and switchgear has already been made. Another interesting contract was some 11 kV 250 MVA 2,000 A capacity duplicate busbar switchgear for Sydney County Council, Australia. There were many other switchgear contracts going through the works for the various Electricity Boards and the National Coal Board. The first three apprentices in the employ of the company who have obtained their higher national certificate in electrical or mechanical engineering were presented to the Princess. These apprentices are the product of the company's advanced apprenticeship scheme.

On the previous day Princess Margaret visited the factory at Merthyr Tydfil of Hoover, Ltd., and saw the production of the company's washing machines. Extensions are being made to the factory to cope with the demand from both home and overseas, and negotiations are proceeding with the Board of Trade for doubling the factory space.

Electrical Export Achievements

Speaking before the Canadian Club, Montreal, on the subject of Britain's industrial recovery, Mr. Leslie Gamage, vice-chairman and managing director of the General Electric Co., Ltd., and president of the Institute of Export, said that the British electrical industry had not only doubled its pre-war volume of exports but had doubled its output in the past three years. They had always been very export conscious in the electrical industry. Even before the war they were the largest exporters of electrical goods in the world and they still were—by a long way.

New House of Commons

For the lighting installation in the new House of Commons (see *Electrical Review*, 20th October, p. 579) the General Electric Co., Ltd., and its sub-contractors used nearly 11,000yd of special heat-resisting cable supplied by British Insulated Callender's Cables, Ltd. This cable—23/0·0076in, single conductor, silicone-rubber insulated, glass braided and silicone lacquered 250 V—was laid in vitreous enamelled channel to connect the 1,209 fluorescent fittings in the scheme. B.I.C.C. also supplied 224yd of "Rockbestos" pipe heating cable for maintaining an even temperature in the oil-feed pipes in the new boiler house.

New Murex Company

In conjunction with Australian associates, Murex, Ltd., has participated in the formation of Murex (Australasia) Pty., Ltd. This company has been formed primarily for the manufacture and sale of Murex arc welding electrodes and equipment, and the full resources of the Murex research organization in England will be available to assist the future development of the company. The head office of the new company, with a modern factory and research department, is to be situated at Derwent Park, Hobart, Tasmania. Branch offices are to be established in all Australian State capitals, and will later be extended to New Zealand. The directors of Murex (Australasia) Pty., Ltd., are Messrs. F. H. Foster, C. P. Flockard and D. E. Hopkins and the general manager is Mr. W. T. Bennett. Mr. E. J. Clarke, director and development engineer of Murex Welding Processes, Ltd., has already arrived in Tasmania to advise on the installation and operation of the new manufacturing plant.

Works Visit

Lord Reith, chairman of the Commonwealth Telecommunications Board, accompanied by Sir Stanley Angwin, chairman of Cables and Wireless, Ltd., and delegates attending the special technical and traffic meetings now being held in London were last week entertained by the directors of the Telegraph Construction & Maintenance Co., Ltd., and Submarine Cables, Ltd., at Telcon Works, Greenwich. The party, after a river trip down the Thames from Charing Cross, made a detailed inspection of the submarine cable factory and other departments associated with the production of telecommunications equipment.

National Radio Show

The 18th National Radio Show is to be held at Earl's Court, London, from 28th August to 8th September, 1951.

Underground Power Station

The dropping of two decimal points in the article on the Lavey (Switzerland) underground power station in our last issue (p. 705) made the cost of the undertaking seem very excessive. Actually it will be between £5·0 and £5·8 million (not £50 and £58 million).

Early Elliott Apparatus

Elliott Brothers (London), Ltd., who this year celebrate their 150th anniversary, are compiling a record of their activities and would like to hear of the whereabouts of Elliott instruments made during the nineteenth century. Founded by William Elliott in 1800, the company originally made drawing and surveying instruments and acquired the business of Watkins and Hill about the middle of the century. The available catalogues show that their products included many types of optical apparatus as well as early electrical apparatus which was supplied to the early experimenters. A calculating machine was developed known as the arithmometer and, towards the end of the century, a wide range of electrical indicating and recording instruments and telegraphic apparatus was supplied. Unfortunately, many

specimens of this old apparatus and interesting photographs were destroyed during the war and the company would welcome any information about its early products. Correspondence should be addressed to Mr. A. H. Attwood, Elliott Brothers (London), Ltd., Century Works, Lewisham, S.E.13.

A window display incorporating the new Cryselco lamp publicity material

Lamp Publicity

The main feature of the 1950-51 lamp publicity material produced by Cryselco, Ltd., is a large cut-out centre piece for window displays which depicts the statue of Liberty holding a Cryselco lamp, with the caption "Liberty from Eye Strain." There is also a smaller showcard based on the caption "Welcome from Darkness," which illustrates a householder opening the door of a well-lit house. In addition to these sales aids the company is issuing general and automobile lamp price lists and broadsheets. In the accompanying picture we show a recent window display in which effective use has been made of the centre piece and showcards.

Valve Productivity Team

Under the auspices of the Anglo-American Council on Productivity a team representing the steel, iron and non-ferrous valve manufacturing industry left on Tuesday last for the United States in the s.s. *Mauretania*. They expect to return from New York on 23rd December.

Wages in the Engineering Industry

On Monday last the National Arbitration Tribunal heard the claim of the Confederation of Shipbuilding and Engineering Unions for a wage increase of £1 a week. The Tribunal's award is expected in about a fortnight's time.

Electrical Commercial Travellers

The annual meeting of the Electrical Trades Commercial Travellers' Association is to be held on 17th November (5.30 p.m.) at the Feathers Hotel, Broadway, Westminster, S.W.1.

Telling the Workers

Most industrialists now accept the idea that their workers should be given a fuller knowledge of what their work means and what they are achieving. The best ways of imparting this knowledge are studied in an illustrated booklet, "Works Information," produced by the Federation of British Industries, 21, Tothill Street, London, S.W.1. Among the media covered are notice boards, posters, wall newspapers, production charts, works journals and magazines, films, exhibitions and works visits.

Telephone Exchanges For Australia

The General Electric Co., Ltd., has been awarded a contract by the Australian Posts and Telegraphs Department for the supply of a further seventy-five 50/200-line automatic telephone exchanges for use in rural areas. Each 50-line unit is entirely self-contained. It can be used either alone or in conjunction with further 50-line units for forming a rural automatic exchange of any capacity up to 200 lines.

Wild-Barfield Extensions

Wild-Barfield Electric Furnaces, Ltd., Watford, Herts, are commencing extensions to their works. Completion of the new buildings will enable a re-arrangement of the existing manufacturing facilities to be made which, it is hoped, will enable still further reductions in delivery periods to be achieved. Much of the current production is of standard furnaces and in many cases export orders are being completed on an ex-stock basis.

Turkish Mining Engineers' Visit

Twelve Turkish mining electrical engineers and technicians have arrived in this country and have commenced a course of training in the operation and maintenance of the flameproof mining equipment ordered early this year from the British Thomson-Houston Co., Ltd., in connection with the development of the Eregli Coal Mines. As coal mining in Turkey has not, hitherto, necessitated the use of flameproof equipment on a large scale, it

was decided that an instructional programme should be provided for the mining electrical engineers to be appointed to responsible positions at the various mines where the new installations would include flameproof units. The course includes visits to the B.T.H. Works, to the works of other manufacturers, and to various collieries.

B.T.H. engineers will accompany the Turkish engineers on their return to Turkey, to supervise the installation of the equipment in the mines. Some of the equipment has already been manufactured, and shipment has commenced.

Lead Price Increase

The Ministry of Supply has announced that from 1st November, the price of good soft pig lead has been increased from £128 to £136 per ton delivered.

Football Ground Floodlighting

For the football match between Southampton and Bournemouth and Boscombe held on the evening of 31st October sixteen Simplex "Reflecto-Flood" floodlights were used, incorporating 1,500 W lamps. The floodlights were mounted on the stands, eight on each side of the ground. The installation was designed and carried out by Mr. B. A. Corry, a Southampton electrical contractor.

Ideal Home Exhibition

The 1951 *Daily Mail* Ideal Home Exhibition will be held at Olympia, London, from 6th to 31st March.

"Ediswan" Lecture Charts

A series of fourteen charts measuring about 19½in by 14½in has been prepared by the Edison Swan Electric Co., Ltd., 155, Charing Cross Road, London, W.C.2, principally for use in schools. The charts show the development of the electric lamp from the first practical example produced by Sir Joseph Swan in 1878 to the tubular fluorescent lamp introduced in 1948. In each case the main feature is a large-scale drawing in which the various parts are clearly indicated and there are also illustrations of details and, where necessary, wiring diagrams. With the charts is a set of lecture notes. Both charts and notes are available to education authorities, schools and lecturers free of charge.

Radio and Television Servicing

The results issued by the Radio Trades Examination Board and the City and Guilds of London Institute show that 264 candidates entered for the radio servicing certificate examination held last May. Of these, 137 were successful and 45 were referred in the practical examination. The first television servicing certificate examination, held last May, was restricted to the London area and thirty entries were accepted. Of these, sixteen candidates were successful and twelve were referred in the practical. The closing dates for the May, 1951, examinations are: Television servicing certificate examination, 15th January; radio servicing certificate examination, 1st February. Forms of application may be obtained from the Radio Trades Examination Board, 9, Bedford Square, London, W.C.1.

Catalogues and Lists

Foster Transformers & Switchgear, Ltd., South Wimbledon, London, S.W.19.—Eight sets of leaflets on the company's range of products ready punched for insertion in the existing loose-leaf catalogue.

Filtrators, Ltd., 92, Seymour Place, London, W.1.—Technical folder on the "Filtrol" photo-electric absorptiometer made for the company by the Edison Swan Electric Co., Ltd.

Nalder Bros. & Thompson, Ltd., Dalston Lane, London, E.8.—Technical leaflet on the "Multimeter" a.c. test set.

Communico, Ltd.—Registered 11th October. Manufacturers of and dealers in television; radio engineers, electricians, electrical engineers, etc. Subscribers: S. W. C. Bateley and G. D. Pegram. Solicitors: Mawby Barrie & Letts, 62/4, Moorgate, E.C.2.

Sturtevant Engineering Co., Ltd., Southern House, Cannon Street, London, E.C.4.—Two technical brochures, No. 7005 on electrostatic precipitation and No. 4101 on heating and ventilation.

John Morris Electrical Engineering Co., Ltd., Market Street, Bilston, Staffs.—Catalogue of automatic voltage regulators.

S. Timings & Co., Ltd., 88, Hamstead Road, Birmingham, 19.—Priced leaflet describing the new "Samtilec" 6 V or 12 V tubular car heater.

Copperad, Ltd., Colnbrook, Bucks.—Priced folder on electric unit heaters.

Trade Announcements

Nettle Accessories, Ltd., has opened new depots at 343, Deansgate, Manchester (telephone: Blackfriars 3524) and at 50, Cathays, Redcliffe, Bristol (telephone 26130).

The address of **Drake & Gorham Wholesale, Ltd.,** Stores and Accounts Department, is now Bashley Road, London, N.W.10 (telephone: Elgar 6213). The head office will continue at 77, Long Acre, London, W.C.2.

Advertisement Correction

We are informed that the address given in the advertisement of Chloride Batteries, Ltd., in the *Electrical Review* of 27th October (page 130) should have been 137 (not 173), Victoria Street, London, S.W.1.

Trends in Insulation Reliability

Promising Newer Approaches to Ageing Aspects

By A. MORRIS THOMAS, B.Sc., F.Inst.P., M.I.E.E.

ALL electrical insulating materials have to withstand mechanical, thermal and electrical stresses and often chemical attack. For this reason no single material, if used alone, is capable of serving satisfactorily as an insulant except in special cases. The particular combination of materials selected depends in the main on the relative importance, or intensity, of these stresses and the possible variations are so numerous that an insulation engineer, besides possessing a fundamental knowledge of the electrical and physical properties of matter, must also be something of an artist in that he must be gifted with a kind of intuitive grasp of all the factors involved in any particular job and of the means best suited to deal with them.

Realization of the difficulties which confront insulation engineers has inspired a laudable attempt to condense and co-ordinate the mass of published information on available insulating materials in the U.S.A.[1] Something of the kind might well be done for British materials, for it is now nineteen years since an authoritative and comprehensive work on the subject by a British author[2] appeared, although an excellent summary[3] was made four years ago.

Electrical engineers, of course, are well aware of the fundamental importance of electrical insulation for the security of operation of electrical machinery and equipment, and there is no intention to flog a dead horse, but as Dr. Johnson said on one occasion: "Sir, are you so grossly ignorant of human nature as not to know that a man may be very sincere in good principles without having good practice?"

An analysis of 3,439 failures of electrical apparatus revealed that 84·8 per cent was caused by insulation breakdown. The failures were classified with respect both to cause and to position, with the results summarized in Tables 1 and 2 (based on American data).[4]

Admittedly this analysis was made in 1934 and it may be, indeed is probable, that great improvements have since been made in materials and processes; but the constant striving towards higher operating efficiencies, reduced space factors, increased power-to-weight ratios necessitated by sales competition, all tend to absorb such improvements and to leave the security margin relatively unchanged.

In general, for low and medium voltage components (say up to 30 kV) apart from a few exceptional applications, the present-day

TABLE 1.—PRIMARY CAUSES OF INSULATION FAILURES

	Per thous.
Loosening of band wires, wedges, etc.	48
Accumulation of foreign matter on windings	49
Carelessness or ignorance of operator	20
Overheating, sustained overload and other causes	45
Excessive moisture in air	47
Flooding and inundation	27
Lightning or line surges	174
Single phasing for all causes	51
Insulation breakdowns between turns	69
Insulation breakdown between commutator bars or slip rings	33
Insulation breakdown between ground and bars or rings	19
Short circuits in control apparatus, switchboards, etc.	34
Number per thousand of definitely classified failures	695
Miscellaneous electric failures (not included above)	80
Undetermined causes	652

TABLE 2.—POSITIONS OF INSULATION FAILURES

	Per thous.
Rotor or armature winding	213
Stator winding	432
Field coils	31
Brush-holder rigging	7
Commutator or collector ring	133
Band wires or wedges	8
Brake coils	18
High-voltage winding (transformers)	28
Low-voltage winding (transformers)	11
Busses, bushings, instrument transformers, stationary coils	52
Low-voltage releases, relay, overload coil, etc.	67

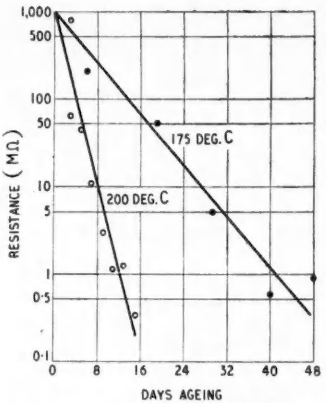


Fig. 1.—Decrease of insulation resistance (logarithmic scale) in salt water of varnish films with time of ageing (dry) at elevated temperature—Dakin[5]

criteria for the selection of insulants are their mechanical properties and thermal stability. The electrical properties—strength, resistance, power loss—will always be adequate provided contamination by impurities, such as dirt and electrolytic substances, is avoided in manufacture and processing and that correct design principles are utilized. Carelessness in these respects can be fatal.

Practically no organic insulation is in a state of stable equilibrium; oxidation, polymerization, or degeneration is in progress continuously, albeit at so slow a rate normally that the change may be imperceptible over a period of years. Such changes, however, are invariably accelerated by exposure to high temperatures and from this fact is derived the importance of ageing tests. In my opinion a deeper and more detailed study of ageing processes would be well worth while. It should be possible to derive an estimate on scientific principles of the life of an insulant at temperatures likely to be experienced in service from laboratory determinations at some higher temperatures. Hitherto the rule for making such extrapolations has been empirical, or even nothing more than guess-work. A rule often employed in the U.S.A. is that the life of insulation operated continuously at a given temperature is reduced by half if the operating temperature is increased by 10 or 12 deg C, as the case may be. A more scientific approach would be by the application of the modern theory of rate processes and a start in this direction has been made by Dakin.[5] The theory indicates that a given property—say tensile strength—is likely to be some simple function of the concentration of some constituent and that the rate of change of such concentration with time is often of an exponential type. In general, however:

$$f(P) = -Kt \quad .. \quad .. \quad .. \quad (1)$$

where f (P) is some function of the property used as criterion of deterioration which is independent of temperature,* t is the time and K is a rate constant independent of time but dependent on temperature. Furthermore, the temperature dependence of a reaction rate very closely follows an

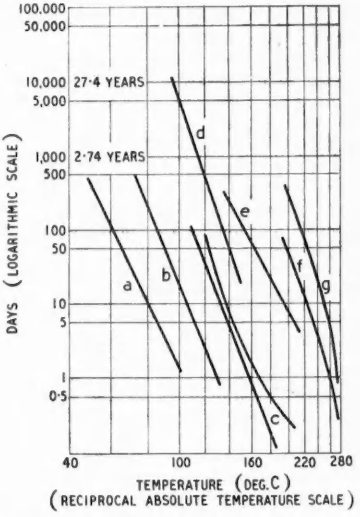


Fig. 2.—Days life (logarithmic scale) of various forms of insulation versus reciprocal absolute temperature—Dakin[5]

(*a*) d.c. capacitor life at 1,000 V/mil, no inhibitor;
(*b*) d.c. capacitor life at 1,000 V/mil, stabilizer added;
(*c*) America Society for Testing Materials, flexiole life of organic varnishes;
(*d*) time to reach 20 per cent tensile strength of manila paper sealed in oil under nitrogen;
(*e*) time to reach 1 per cent original resistance of an organic varnish film measured in salt water solution;
(*f*) American Society for Testing Materials, flexible life of 990 A silicone varnish film;
(*g*) time to appearance of visible cracks in 990 A silicone varnish film.

* Impregnated paper capacitor life (electrochemical deterioration) is a function of the charge passed; that of R.F. cables is related to number of cycles of stress (E.R.A. & N.P.L. work to be published shortly in *Proceedings* I.E.E.).

xponential law :

$$K = A e^{-B/T} \quad .. \quad (2)$$

where A and B are constants and T is the temperature on the absolute scale ; combination of (1) and (2) gives : log $\left(\frac{f(P)}{t}\right) = -B/T + \log A$, or $\log (f(P)) - \log t = -B/T + \log A$ .. (3). Suppose P is the tensile strength and some fraction, say 0·2P, is taken as determining the life ; then the log of the time for the tensile strength to fall to 0·2P when plotted against I/T is usually a straight line which can be extrapolated with some confidence. This fact incidentally shows the fallacy of 10 or 12 deg C rules, since temperature intervals at high temperatures have less effect than the same interval at lower temperatures. Further details cannot be given here, but the predictions of the theory have been verified in many cases. For instance, in a high temperature accelerated ageing test on varnish films (Fig. 1) the property employed as criterion of deterioration is the logarithm of the insulation resistance in salt water. That the latter parameter is a valid criterion is indicated by the linearity of the curves for the two temperatures. Hitherto, the procedure commonly adopted has been to plot the deterioration parameter (decrease in insulation resistance, tensile strength, etc.) against the logarithm of the time. A set of examples illustrating the application of equation 3 is reproduced in Fig. 2.

This new and fundamentally scientific approach to the problem of ageing tests is very promising and its further development should be of incalculable value for insulation reliability.

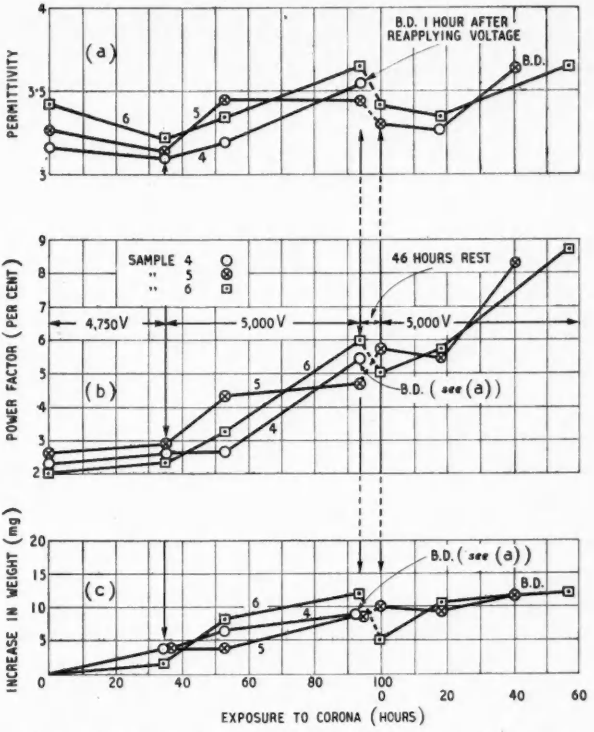


Fig. 3.—Deterioration of 5-mil black varnished cloth caused by the action of corona (corona layer above sample = 0.19 cm; applied 4,750 V and 5,000 V r.m.s.—Thomas[7]

It is now generally accepted in high voltage technique that external corona or discharges impinging on insulation, or internal discharges occurring in gaseous inclusions and voids, cause a rapid loss of insulation strength. The gaseous products of the discharges react chemically with the material and cause a general, or diffused, form of deterioration; at the same time some form of localized, or microscopic, deterioration occurs independently, which ultimately results in a puncture. The progress of deterioration of a sample of black varnished cloth when subjected to maintained discharges (Fig. 3) involves a gradual increase in dielectric loss and chemical change (increase in weight) but puncture usually occurs at some instant owing to some local action which is not correlated with the macroscopic effects.[7]

Evidence is now accumulating that corona discharges occur in machines of quite moderate voltage ratings and exercise a detrimental effect on insulation life ; in fact corona can occur at a few hundred volts at ordinary atmospheric pressures and is likely to become severe at lower pressures, such as prevail in aircraft. Tests made in the U.S.A. on an aircraft dynamotor (Fig. 4) have established a good correlation between life and corona inception voltage.[6] The conclusions induced manufacturers of small rotating machines to introduce the corona inception voltage test as a means of quality control in the production line.

Insulation failure caused by the process called surface tracking has hitherto perhaps failed to receive the attention it deserves. A special study of this problem is now in progress under the auspices of the E.R.A., which has accepted the following definition : " Tracking denotes the progressive formation of electrical conducting paths which are produced on the surface of a solid insulating material by the combined effects of a tangential component of an electric field and of deterioration in electrical leakage resistance caused by external agencies."

Several methods of testing have been devised in order to compare the " tracking resistance " of insulants. They fall more or less into two classes according to whether the surface deterioration is accelerated by (1) allowing an electric arc or discharge to impinge on the surface or (2) depositing water or an aqueous salt solution on the surface and simultaneously applying a tangential electric stress. None of these tests has been found entirely satisfactory.

In the cases of moderate and low voltage machinery and apparatus there is general agreement that the primary cause of tracking is surface contamination by moisture in association with dirt deposits, the composition of which will depend on the environment. In the opinion of the E.R.A. investigators the so-called " Admiralty " test is probably the best means of assessing the relative merits of various insulants with respect to tracking. Reference may be made to the E.R.A. report[8] for further details.

We have been informed by the powers-that-be that we must " export or die " so that the importance of maintaining the goodwill of our markets overseas scarcely needs emphasizing. Every effort must be exerted to maintain, indeed to improve, the reputation of the products of our electrical industry and it is my contention that the endeavour will succeed or fail primarily on the quality and reliability of the electrical insulation. It is hoped that the foregoing contribution will help to focus attention on some important aspects which might otherwise be neglected.

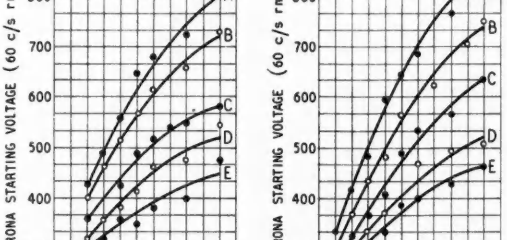


Fig. 4.—Corona starting voltage at various altitudes for varying thickness of insulation with (left) coils parallel and (right) coils perpendicular—Jones and Stanbery[6]

[1] M. A. Faucett, C. Houpis and G. E. Leibinger : " A Survey of Insulation Practices," Engineering Experiment Station Circular Series No. 57, 1949, University of Illinois, Urbana, U.S.A.

[2] H. Warren: " Electrical Insulating Materials " (a book), Ernest Benn, Ltd., 1931.

[3] " Electrical Engineer " Reference Book, George Newnes, Ltd. (2nd Edition) 1946.

[4] D. F. Miner : " Insulation of Electrical Apparatus " (a book), McGraw-Hill, 1941.

[5] T. W. Dakin : " Electrical Insulation Deterioration Treated as a Chemical Rate Phenomenon," A.I.E.E. technical paper No. 48, 19 Dec., 1947 (Westinghouse Research Lab. scientific paper No. 1,314).

[6] R. D. Jones and E. M. Stanbery : " Design of Insulation for Small Machines," *Elect. Engg.*, N.Y. Vol. 69, p. 144, Feb., 1950 ; A.I.E.E. paper No. 49-213.

[7] A. M. Thomas: " The Effect of Corona on Solid Insulating Materials," *Journ.* I.E.E. Vol. 91, Pt. II, Dec., 1944, pp. 549-562.

[8] V. E. Yarsley and W. J. Grant: " Tracking in Solid Insulating Materials: a Critical Resumé," British Electrical & Allied Industries Research Assoc. report ref. L/T177, 1948.

ELECTRICAL CONTRACTING: Organization and Routine

By H. R. TAUNTON, A.M.I.E.E.

15.—The Stores and Stock

THE electrical contractor's store might be idealized as a perfect vacuum. The nearer it approaches that ideal, the firmer the foundations of his business; the emptier his basement—the usual locale of his store—the sounder the roof over his head. Overstocking, with all its attendant evils, is one of the commonest of the calamities which dog the hard way of the contractor. The golden rule, then, is to keep stock as small as possible. It should comprise no more than is essential to the convenient working of his business, having regard to the nature of the work customarily undertaken by the firm, and the conveniences available in the shape of local suppliers.

Extent of Stock

In normal circumstances most firms ought to be able to keep their stock down to 2 per cent of their annual turnover. If they can manage with less, so much the better; and there is no reason why they should not, by taking a little pains.

The disadvantages of an unnecessarily large stock are many and most of them are obvious. There is the extra space needed, with its extra lighting and heating and maintenance. There is the extra staff needed for handling the stock, booking it in and out, listing and pricing it. The mere volume and complexity of the material involves delays and difficulties in finding what is wanted and disposing of what is not. There is the point, too, of loss of interest on dormant capital: whatever is in the store has presumably been paid for, but until, if ever, it is used, it is bringing in no return. All these are direct increases of standing charges, entailing a reduced margin of profit on competitive work. Less obvious are the losses from depreciation and obsolescence.

Perfectly sound stock, however, carefully stored, may yet by the lapse of a few years become worthless through the introduction of improved patterns, while it figures all the time in the stock list at its original cost. Depreciation is of two kinds. There is the natural depreciation due to atmospheric conditions and to continual handling: rusting, tarnishing, scratching, and chipping. And there is the depreciation due to lowered market prices. Finally, there is actual loss: reductions in quantity due to breakages and all sorts of mysterious causes, despite the most elaborate checking.

Of course, all this affects the small stock as well as the large one; but the proportion of loss in the latter case is usually larger, as any increase in volume beyond working needs means a less frequent turning over of stock, involving obsolescence and a greater liability to deterioration, damage, and leakage. The advantages of a small stock follow as the converse of the above; and it is needless to stress the point further. Keep the stock down to the lowest practicable limits and keep it moving up to date.

Maximum–Minimum System

The problem is how best to ensure that stock is kept within manageable proportions. The first essential is the adoption of the well-known system of minimum and maximum quantities. Every bin or receptacle in the store should bear an index, a description of the contents and, in big, bold figures, two numbers representing the limit below which they should not be allowed to fall, and limit which they must not exceed. These will naturally vary with the peculiar needs of the business, and they may vary too from time to time. The important point is that they should be kept as low as possible and, once fixed, rigidly adhered to. A common reason for buying excessive quantities of stock is the temptation of a quantity discount; but what is the point of earning an extra 5 per cent if it is lost in the first year in the shape of interest on idle capital.

The maximum and minimum system, while it is a check on the undue accumulation of material, does not of itself prevent the total volume of the stock exceeding its prescribed limit. It may grow by excessive variety as

well as by excessive quantity. Only constant scrutiny will stop the gradual addition to it of unnecessary items and sub-varieties of necessary items. As soon as these intruders are detected they should be allotted a maximum limit of "0," so automatically preventing their renewal unless, or until, judgment or experience dictates the advisability of making them permanent stock items. All such additions to the varieties of material should be made grudgingly and sparingly. It is folly for a contractor to attempt in his store to cover the range of a wholesale catalogue.

Before any goods are ordered against requisition, the buyer or storekeeper should consider the possibility of substituting some stock item for a slightly different item requisitioned. For example, it might well pay to send a foreman a length of 19/·064 from stock when he asked for 19/·052, not in stock. This would not only save the 10 per cent extra which would have to be paid on the cost of a short length, but maintain the principle of keeping the stock moving.

Returns from Contracts

Stock is apt to become unduly swollen both in variety and quantity by returns from contracts of material ordered in excess of requirements. That, if consistently recurring, argues a fault in foreman, supervisor, or buyer; but circumstances often make it excusable. All that can be done is to minimize its disruptive effect. If the quantities are large—dozen lots, uncut coils, and so on—or are special items of value, every endeavour should be made to induce the suppliers to take the goods back for credit, even if it means some slight sacrifice.

Most factors will be found willing, in return for definite contracts extending over a period, to allow odd lots to be ordered at quantity prices, and it is sometimes possible to induce them to accept the return of odd lots on the same terms. In this way a contractor, with a little diplomacy, can achieve the desirable end of having the bulk of his working stock kept for him by his factor.

Finally, stock is apt to grow by the accumulation of slightly damaged or deteriorated material, generally originating as returns from contracts. If this is stored away without discrimination among the good stock, it will in time, form the large nucleus of it, unused until it becomes unusable, and every year worth less and less than its nominal value in the stock list. There is a natural tendency for anyone selecting material for a job to prefer the new unopened coil of flex, or the accessory still in its original carton, to the slightly shabbier article.

Any returns, or material slightly depreciated but still sound and usable, should be kept in the forefront of the bins and the rule observed that it must be cleared before any new material is touched: cable and flex should be neatly coiled and labelled; small accessories should be put back in the original cartons, if available; articles like white enamelled blocks, easily soiled, should be wrapped in paper. In short, all this not-quite-new material should be treated as tenderly as if it were new. The procedure is not so simple with stuff which, while quite sound, is yet too markedly depreciated to be usable on new work. Probably the best compromise is to let it remain in the usual bins well exposed to view and star it as separate items in the stock list, where it can be priced at some simple reduction of the standard cost.

A common case is that of c.i. boxes returned drilled from jobs for which they have proved unsuitable. They may lie in stock for years because nobody wants the trouble of turning over a mass of heavy ironmongery, all looking very much alike, when a box with particular drillings is needed. To meet this, a rough list should be fixed to the bins showing the various sizes and drillings of the boxes in them. C.i. goods in general—fuseboards, main switches and accessories—need rarely prove permanently bad stock, as a touch of enamel will usually serve to make them presentable.

Damaged Material

Goods actually damaged require more drastic treatment. Cracked or broken glass, porcelain, bakelite and wood accessories are hopeless. The rest should be sorted out—damaged castings, odd lengths of cable, brass or copper parts—and periodically sold as scrap.

Apparently damaged material can often be salvaged for usable stock. Six tumbler switches may be returned from a job, half with broken bases and the other half with covers missing. A minute's work by a boy would make of them three sound switches. In the same way holders without shade-rings, or ceiling roses lacking a terminal, otherwise left to indefinite neglect in their bins, can easily be fitted with the needed parts from others of the same pattern which have been thrown aside as worthless.

The contractor's stores are usually to be found in a basement. The ground floor would be better for convenience of handling, but as a rule the valuable space there is needed for other purposes. The first or upper floors are obviously unsuitable. If it is in the basement it must be provided with a convenient opening to the street or yard, through which conduit and similar bulky material can be passed to avoid awkward carrying up and down stairs ; and similarly, a trap with a hoist for heavy goods is very desirable.

Admission to Stores

If possible, there should be two separate entrances : one communicating with the rest of the premises, and the other opening to the street, for the use of workmen and messengers. The latter, with a suitable waiting space, should be separated from the actual stores by a partition and a counter. Even if there is no separate entrance for the men, a lobby and counter should still be provided. There must be a strict rule that only the stores staff (and certain members of the office staff) should be admitted to the stores themselves. It is not always an easy rule to enforce. A harassed storekeeper will often be tempted to let a foreman come in to select some particular item that will best suit his job or to collect his own material, or he will impress a messenger to help him handle some outwards consignment.

Once that sort of thing is allowed, good-bye to all efficiency. The stores is too apt, in the best of circumstances, to become a mixture of canteen and mothers' meeting, where gaping lads may hear their elders swopping anecdotes at three-and-something an hour. Bad enough if it is confined to the waiting space, but if these gossipers and idlers are allowed to lounge about the stores, they are not only more difficult to dislodge, but they impede the work there and increase the chances of damage and loss of stock. Even worse is the inevitable breakdown of the organization. None but the stores staff, who can be trusted to observe the necessary routine, should be allowed to handle stock in any way, in or out, which may affect the accuracy of the records.

Coming finally to the stores proper, these should be dry, well ventilated, and well lit ; and the roomier they are within reason the better. Space has to be provided in it for the storekeeper's desk with telephone, and for shelving for his files, advice books, catalogues, etc. A lock-up cupboard is desirable for certain items. A clear space, too, will be needed for packing, with a wide bench and conveniences for packing material.

Leaving a certain floor area for the bulky items which will inevitably, if only temporarily, drift into the stores, such as motors, fans, radiators, and the like, storage of the normal stock is only a matter of lining the walls with suitable racks, bins, and shelving. Unless the space is very narrow, other rows of bins can be planned in the central area, leaving suitable gangways and avoiding dead ends. Generally speaking, none of these receptacles should be above hand-reach. An all-steel construction has certain advantages, lessened fire-risk being the chief, but it soon gets knocked about, shabby and rusty. Wood, besides being cheaper, actually keeps in better condition. A compromise of angle-iron framing, with expanded metal or wire-mesh divisions, but wood shelving, provides the best construction.

Different kinds of stock clearly need different accommodation : lengths of conduit cannot be stored in pigeon-holes. They are best kept on horizontal racks formed of wide wrought-iron brackets, planned in line with the exit, to avoid negotiating awkward corners. The larger types of conduit accessories, boxes, and other c.i. goods not easily damaged can be stored in bins at or near the floor level : compartments with solid or slatted fronts extending about half their height.

Storage of Accessories

General accessories, such as holders, switches, etc., should be stored in similar but shallower bins above floor-level, preferably with slatted bottoms to minimize the collection of dirt. They should have wood ledges in front, to avoid goods being crowded off and falling to the floor. They can with advantage be fitted with an internal shelf about halfway up and of half the depth of the bin ; and if both bin and shelf have vertical dividing pieces it will allow a certain sub-classification of patterns.

As a general principle, every different type and pattern of material should have its own bin or a separate compartment of one, but in practice this ideal is often difficult to achieve. At least it should be aimed at. To mix half a dozen patterns of, say, tumbler switches in one receptacle adds considerably to the

difficulty of handling, recording and stock-taking. It is better, therefore, to plan for a large number of small bins than for fewer large ones. They should not extend too far from the front, or the back will not be easily reached ; nor be too deep from top to bottom, or the upper space will be wasted, especially with small goods which cannot be stacked. In the case of articles like screws and wall plugs, the bins may become practically pigeon-holes.

Certain articles, such as shades, may be more conveniently stored on shelves with shallow guards and vertical partitions, rather than in bins. In any case, glass and porcelain goods are always best kept well up above danger of other things falling on them.

Cable can be stacked in large bins, horizontally for the smaller sizes, vertically for the larger. Very heavy cables and lead-covered or armoured cables will have to be stacked on wood battens at floor-level. Large wooden pegs fixed in odd corners are useful for broken coils or short lengths, which, in ordinary bins, are apt to be overlaid and overlooked. Similarly, flex, if in unbroken coils or cartons, can be stored in bins ; but broken coils need something more if waste from tangling and soiling is to be avoided. Shallow trays with a solid drum in the centre, round which the flex can be wound, solve the difficulty well. C.t.s. flex can be treated as cable.

Drawers are generally a nuisance in a store, but they may be used, with or without divisions, for certain small items in place of pigeon-holes. The lock-up cupboard before mentioned will be found useful for the keeping of small stock which may be of high intrinsic value.

The arrangement of the several types of receptacles will naturally depend upon circumstances. Whatever it is, it should as far as possible follow some logical system ; that is to say, goods of the same kind should be kept and classified together, so far as is consistent with the general principle of keeping heavy stuff close to the ground, stuff most commonly used at the most convenient level, and fragile and rarely used stuff above. In practice a compromise is always necessary, which will be arrived at by day-to-day experience.

Nothing need be said here of showroom stock. Its character is essentially different from that of the jobbing stock ; and in any case most of it is not so much stored as displayed, in what is in effect the first stage of a sales operation.

On large contracts it may be necessary to organize small sub-stores. One cannot expect in them the high organization of head-quarters, but it should be aimed at as an ideal : the same principles of storing goods, of listing, and of booking in and out should be followed as closely as circumstances permit. The responsible supervisor, or, when possible, the head storekeeper, should by frequent inspection and random checks guard against its degeneration into the unholy chaos all too common in contractors' stores.

500 kV Linear Accelerator

IN the September issue of the *Review of Scientific Instruments*, the journal of the American Institute of Physics, Wayne R. Arnold of the State University of Iowa describes a 500 kV generator for use on a linear accelerator.

The voltage multiplier circuit usually employed to give voltages of 500 kV or less is a two- or three-stage multiplier using hot filament X-ray tube rectifiers. Such circuits require the use of condensers and rectifiers which must be rated at one-half to one-third of the total output voltage. They also require batteries, generators or high voltage insulation transformers to heat the rectifier filaments.

In the machine described selenium dry disc rectifiers are used so the problem of filament heating does not arise. It is then convenient to use a greater number of stages of multiplication; more stages with the same output voltage result in a reduced voltage across each component. Although for a given load there is a limit to the number of stages of multiplication that can be used, proper choice of condensers and input frequency make this limitation relatively unimportant.

In the machine in question selenium rectifiers and 1 μF condensers are used in 22 stages of voltage doublers, the maximum input is 9 kV r.m.s. at 750 c/s, and the maximum peak inverse voltage across each rectifier and each condenser is 25 kV. The measured regulation is 25 kV/mA, the measured ripple (peak to peak voltage) is less than 1,200 V/mA, both independent of output voltage. The maximum load is 2·5 mA. The circuit used is essentially the same as that employed by Cockcroft and Walton (see Proc. Royal Soc. 129, 477–1930 ; Proc. Royal Soc. 136, 619–1932; and Bouwers and Kuntke, Zeits. f. Techn. Phys. 18, 209–1937).

ELECTRICITY SUPPLY

B.E.A. Power Plant Contracts
Load Shedding in Many Areas

DURING the past month the British Electricity Authority has placed contracts for equipment for power stations, and transforming stations and transmission lines amounting in the aggregate to £2,095,669. The principal contracts include the following :—Tilbury : Access roads, railway sidings and preliminary works.—Holloway Bros. (London), Ltd. Meaford "B" : Foundations and railway sidings. G. Percy Trentham, Ltd. Turbine and boiler house steelwork.—Cleveland Bridge & Engineering Co., Ltd. Bold : 33 kV, 750 MVA switchgear.—A. Reyrolle & Co., Ltd. Doncaster : 66 kV, 1,500 MVA switchgear.—A. Reyrolle & Co., Ltd. Swindon substation : Two 45 MVA 132/33 kV transformers and earthing transformers.—General Electric Co., Ltd. Canterbury and Littlebrook substations : 132 kV, 1,500 MVA switchgear.—English Electric Co., Ltd. West Melton–Wharncliffe : 132 kV line.—Watsham's, Ltd. Keadby–Scunthorpe, Lincs : 132 kV overhead line.—British Insulated Callender's Construction Co., Ltd. Plymouth "B" : Steam feed and drain pipework.—Babcock & Wilcox, Ltd.

Rapid Tunnelling

Twelve workmen who drilled 245ft in seven days in Ben Buidhi, near Loch Fyne, Argyllshire, are said to have broken the British record for tunnelling through hard rock. The tunnel, which is 11ft 4in in diameter and will be four miles long, is part of the Glenshora hydro-electric project.

Extensive Load Shedding

The most severe load shedding of the winter occurred at the beginning of last week—up to 25 per cent in the North and 20 per cent in the South. In Yorkshire some domestic consumers are reported to have been without electricity for over four hours in the morning of 30th October and again for an hour in the afternoon. In Leeds large areas of the city were deprived of a supply for many hours, the districts most affected being Gledhow, Headingley, Kirkstall, Middleton, Cross Flatts and the Cottingley, Wyther Park and Sandford estates. At Normanton, after a five-hour morning cut which held up local factory work, there was a further cut in the evening from 4.30 to 6.10 p.m. Shops and offices in Huddersfield were in darkness in the evening, all the feeders serving the centre of the town being disconnected. In the West, the Welsh Regional Board for Industry was left in darkness when it had the question of power cuts on the agenda for discussion. It passed a resolution calling on its headquarters in London to consider the difficulties in South Wales.

Electric Refrigerators Preferred

An indication of people's preference for electrical apparatus in the home is noted in the "Eastern Electricity Bulletin." The Thurrock U.D.C. recently offered to provide its tenants with refrigerators on hire. The tenants were offered the choice of gas or electric refrigerators, the size of the refrigerators and the amount of the hire-charge being the same. Although a special sales effort was made by the Gas Board, 1,395 (or 89 per cent) of the 1,559 who have so far taken advantage of the Council's offer, have chosen an electric refrigerator.

Farm Supplies

At a meeting in London last week the Country Landowners' Association passed a resolution deploring the delay by the British Electricity Authority in reaching a decision on the abolition of capital charges for supplying electricity to farms. The Association felt that abolition of these charges would greatly encourage rural electrification.

Rural Extension

The North of Scotland Hydro-Electric Board has extended distribution lines to Rothienorman, Aberdeenshire. As a result of the extension 20 homes in the village were given a supply on 23rd October and another 20 will be switched on within the next few days. Cooking demonstrations and a display of the latest electrical appliances in the village hall have been arranged by the Board for their new consumers.

Government Assistance Urged

Government financial assistance in supplying electricity to the rural areas of the North of Scotland is urged in a communication sent by the Electricity Consultative Council to the North of Scotland Hydro-Electric Board. The most promising proposal considered was, in the Council's view, a scheme for equalizing the cost of distribution among rural consumers in any

particular district. Typical examples of such a scheme were worked out by the Council from figures given by the Board, and it was found that a basic annual guarantee of £3 10s per room or per 1,000 sq ft of steading space would be required. The Council's opinion, however, was that this figure would have to be reduced to £2 before the scheme became attractive to the majority of farmers. It therefore came to the conclusion that some form of Government assistance should be sought, particularly in view of the rapid depopulation of many districts. It recommended the working out of a system of State grants to deserving cases or groups of cases, and pledged its support should the Board submit a proposal for Government assistance to the Secretary of State for Scotland. In Eire, it is pointed out, a 50 per cent State grant was paid in rural areas. In some areas mains supply would never be economical and it recommended the provision of small power plants.

Chester Lighting Experiment

Vertical type fluorescent lamps have been installed experimentally in St. Werburgh Street, Chester.

First Trolley-Buses for Uruguay

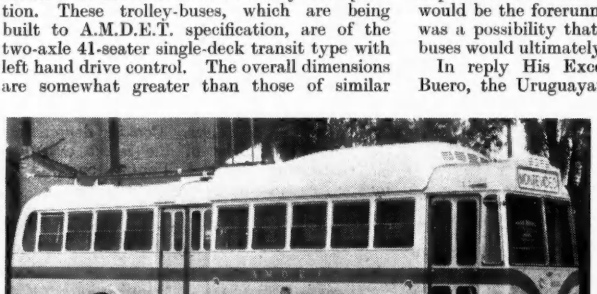
A FEW days ago we were invited to be present when the first of eighteen trolley-buses ordered by the Administracion Municipal de Transportes Colectivos de Montevideo (A.M.D.E.T.) was given a demonstration run on the London Transport Executive's system at Hampton Court. The order for these vehicles was obtained by Balfour, Beatty & Co., Ltd., on behalf of a British Trolley-bus Consortium comprising in addition to the latter company the British Thomson-Houston Export Co., Ltd., British United Traction, Ltd., English Electric Export & Trading Co., Ltd., Metropolitan-Vickers Electrical Co., Ltd., Sunbeam Trolley-bus Co., Ltd., Metropolitan-Cammell Carriage & Wagon Co., Ltd., Park Royal Vehicles, Ltd., and Weymanns, Ltd.

It is worth noting that this order was obtained in the face of severe competition from both American and Continental manufacturers. This initial order, for the first trolley-buses to be operated in Uruguay, is eventually hoped to lead to much larger repeat orders as more routes in Montevideo are converted to trolley-bus operation. These trolley-buses, which are being built to A.M.D.E.T. specification, are of the two-axle 41-seater single-deck transit type with left hand drive control. The overall dimensions are somewhat greater than those of similar British vehicles, the length being 34ft 7in and the width 8ft.

The electrical equipment is composed of standard components of the member firms to provide for simplified maintenance and long periods of operation without attention. The main motor is the Type 210, which to B.S. 173/1941 at 550 V has a one-hour rating of 125 h.p. and a continuous rating of 115 h.p. The design is such that the ingress of flood-water is effectively prevented, even if it be immersed up to the centre line for short periods. All controls and auxiliary equipment follow standard practice apart from the fact that contactor gear is mounted at the rear of the vehicle in a special dustproof metal-panelled asbestos lined compartment.

Speaking at a luncheon which was given after the demonstration run, Mr. Ian C. A. Murray (Balfour Beatty & Co.) proposed a toast to the guests. He made particular reference to the good will which had always existed between this country and Uruguay and expressed the hope that the initial success of the Consortium would be the forerunner of many more. There was a possibility that in all about 650 trolley-buses would ultimately be needed.

In reply His Excellency Don Enrique E. Buero, the Uruguayan Ambassador, expressed his appreciation of the high standard of workmanship which had been maintained under severe competition. He felt that the vehicle expressed friendship and cordiality between the two countries.



The first of eighteen British trolley-buses for Uruguay

FINANCIAL SECTION

Company Notes and Stock Exchange Activities

Reports and Dividends

Bennis Combustion, Ltd.—The annual meeting was held on 30th October, Mr. T. Hough (chairman and managing director) presiding. In his statement circulated with the report and accounts the chairman said that they had achieved a level of profit during the past year which had only once been exceeded in the company's history. They had been allocated four large high-pressure water tube boilers for a power station in the 1953 and 1955 programmes of the British Electricity Authority; these entailed a year or so of preparatory work, credit for which would only be revealed in their figures at some future date.

Holophane, Ltd., reports a net profit for the year ended 30th June last of £89,703. After providing £45,850 for taxation and writing off £396 from patents account, there is a balance of £43,457 as compared with £29,744 for the previous year. General reserve receives £30,000 and it is proposed to pay a final dividend of 7½ per cent on the ordinary stock, again making 15 per cent for the year. The balance carried forward is £36,442 (against £29,092 brought in).

Reliance-Clifton Cables & Industrial Products, Ltd.—The accounts of the group cover eight months for the parent company and the year to 30th November last of subsidiaries. The trading profit is £229,911 and dividends and interest, etc. £2,948, making £232,859, as compared with £206,204 for the preceding year. The net profit is £93,466 (against £85,695), to which is added £27,223 brought in, making £120,689, of which £75,520 is allocated to reserves. The interim ordinary dividend was 10 per cent, and the proposed final dividend is 6⅔ per cent, leaving a balance to be carried forward of £29,567.

The East African Power & Lighting Co., Ltd., reports group operating surpluses and sundry receipts, income from investments and deposits and transfer fees, totalling £465,009 for 1949, as compared with £349,746 for 1948, and a net revenue of £267,908 (against £173,903), which with £87,970 brought in, makes £353,878 available. After deducting East African income tax, £9,109, and placing £52,500 to reserves, it is proposed to pay a final ordinary dividend of 4 per cent, making 7 per cent for the year. The final ordinary dividend is paid on capital increased by an issue of 1,000,000 £1 ordinary shares in October, 1949, when 1,000,000 4 per cent preference shares were also issued. The balance carried forward is £114,520. The report states that a further issue of capital will be required in due course to provide for additional commitments due to the expansion of the company's programme of extensions. Resolutions will be submitted to the annual meeting on 21st November, increasing the authorized capital from £4,500,000 to £6,500,000.

Burco, Ltd., reports a profit for the year ended 30th September last, after deducting all charges, including £62,001 for taxation, of £62,806, as compared with £36,535 for the preceding year. The proposed final dividend is 25 per cent, making 35 per cent for the year (same), and it is also proposed to pay a bonus of 7½ per cent (against nil).

Kerry's (Gt. Britain), Ltd., has declared an unchanged interim dividend of 3¾ per cent.

The Hackbridge & Hewittic Electric Co., Ltd., is paying an interim dividend of 5 per cent (against 4 per cent).

Revo Electric Co., Ltd., has announced an interim dividend of 5 per cent (unchanged).

Broadcast Relay Service, Ltd., has announced an interim dividend of 8 per cent, tax free.

The Sun Electrical Co., Ltd., has declared a dividend of 10 per cent, against 7½ per cent for the preceding year.

New Companies

George Forrest & Son (1950), Ltd.—Registered 24th October. Capital £100. Manufacturers of and dealers in lamps and lighting devices of all kinds, etc. Solicitors: Rowe & Maw, Norfolk Street, W.C.2. Regd. office: 105/9, Judd Street, W.C.1.

H. G. Cockram, Ltd.—Registered 26th October. Capital £1,000. Electrical contractors, etc. The subscribers are: H. G. Cockram and J. W. Cockram. Secretary: W. H. French. Regd. office: 38a, Park Road, Cheriton, Folkestone.

Castra Electric Washing Machine Co., Ltd.—Registered 25th October. Capital £500. Directors: P. Gibson and H. Brown. Secretary: P. Gibson. Regd. office: Canal Works, Rodley, Leeds.

Hodson (Croydon), Ltd.—Registered 25th October. Capital £1,500. Electrical engineers, repair and maintenance contractors,

plant hirers, etc. Directors : E. C. Hodson (chairman), Doris E. Hodson, R. H. Watkins and F. A. Corbin. Secretary : Doris E. Hodson. Regd. office : 75a, George Street, Croydon, Surrey.

Renmill Electrical Engineering Co., Ltd.—Registered 23rd October. Capital £1,200. Manufacturers of and wholesale and retail dealers in domestic, household and general electrical and other equipment and appliances, etc. Directors : C. G. Reynolds and D. Long. Regd. office : Rear of 33, Vincent Crescent, Balsall Heath, Birmingham, 12.

Electronics (Leeds), Ltd.—Registered 20th October. Capital £1,000. To acquire the business of an electrical contractor carried on by A. A. Haycock at Canal Lane, Lofthouse Gate, nr. Wakefield, as Hayco Electronics. Directors : J. H. Thompson, Mrs. Kathleen A. T. Thompson and A. A. Haycock. Regd. office : Canal Lane, Lofthouse Gate, nr. Wakefield.

Max Arc & Electrics, Ltd.—Registered 27th October. Capital £100. Manufacturers of and dealers in electrical apparatus and appliances, welders, engineers, etc. Directors : P. S. E. Jackson, J. L. Jeffree and J. R. Oliver. Regd. office : 190, Thornton Road, Croydon, Surrey.

Metcalfe Instruments, Ltd.—Registered 27th October. Capital £1,000. Manufacturers of and dealers in precision and scientific instruments of all kinds, etc. Directors : N. H. Metcalfe, B. J. Halse, S. S. Gold and Ralph W. Leigh. Regd. office : 21, Kingsland High Street, E.8.

Electronics (Liversedge), Ltd.—Registered 4th October. Capital £1,000. Electronic, radio and television engineers, etc. Directors : D. Stead and G. Norton. Regd. office : 21, Westgate, Heckmondwike.

Increases of Capital

Noma Electric Co., Ltd.—Increased by £10,000, in £1 ordinary shares, beyond the registered capital of £10,000. At 14th January 1949, Noma Electric Co. of Canada, Ltd., and Britannia Electric Lamp Works, Ltd., held 2,499 and 7,499 £1 ordinary shares respectively, out of 10,000 issued.

E.G.S. Co., Ltd.—Increased by £40,000, in £1 ordinary shares, beyond the registered capital of £20,000.

L.M.K. Manufacturing Co., Ltd.—Increased by £16,500, in £1 ordinary shares, beyond the registered capital of £8,500.

Bankruptcies

F. A. Barratt, A. J. Barratt and J. P. Smart, trading as "Excel Radio Components," 53, Abington Street, Northampton, manufacturers of wireless sets and components. (Separate estate of A. J. Barratt.)—First and final dividend of 20s in the £, payable 10th November at the Official Receiver's office, 6, The Parade, Northampton.

Rotherham Electronic Service, 46, Kimberworth Road, Rotherham, electrical, radio and television engineers and neon sign specialists.—Receiving order made 24th October on a creditor's petition.

J. F. Husbands, 22, Mettham Street, Lenton, Notts, electrical trade representative lately electrical contractor.—First meeting held 3rd November. Public examination 7th December at the County Court House, St. Peter's Gate, Nottingham.

Liquidations

The Cawnpore Electric Supply Corporation, Ltd.—Members' voluntary winding-up. Liquidators, Mr. A. L. B. Tucker, Orient House, New Broad Street, London, E.C.2, and Mr. D. C. Wilson, Winchester House, Old Broad Street, E.C.2. (The Corporation's undertaking was compulsorily acquired by the Government of the United Provinces on 15th September, 1947, and the Corporation ceased to do business from that date.)

Anglo-Brazilian Agreement

A NEW Anglo-Brazilian trade agreement, back-dated to 1st July, and in force for twelve months, provides for exports to Brazil valued at £44,620,000, and imports to the value of £51,440,000. The difference of £6,820,000 is to offset Brazil's normal deficit in its balance of payments with Britain.

Electrical products to be exported to Brazil include : apparatus and spare parts for telegraphy and telephony, £350,000; apparatus and parts for television, £200,000; parts and accessories for wireless receivers, £350,000; electrical apparatus for domestic use, £50,000; unspecified electro-medical apparatus, £150,000; dynamos, alternators, generators, etc., £250,000; dry batteries, £25,000; transformers, over 2,000 kVA, £100,000; underground cables and wires, £50,000; fittings for electrical installations, including switchboards and panels, £300,000; electricity meters, £60,000; electrical signalling apparatus for railways and other purposes, £100,000.

In addition to the above the following sums are allotted to exports of machinery, apparatus and accessories, which will include appreciable quantities of electrical equipment : for sugar and alcohol industries, £400,000; unspecified foodstuff industries, £300,000; textile industries, £4,000,000; other unspecified industries, £1,000,000.

STOCKS and SHARES

STOCK Exchange business is certainly a good deal more active than it was two or three months ago. Political apprehensions seem to have given way to a feeling of more confidence, though why this should be the case, it might be difficult to explain. The fact remains, nevertheless, that stocks and shares are attracting an interest which becomes more widely spread with every week that passes. This may be due in no small measure to the nationalization plans that have resulted in thousands of investors being now in possession of British Government securities, the income from which is as modest as the security is sound, but which fail to compensate, in any adequate way, for the rising costs of living. In consequence, investors are not only willing, but anxious, to exchange British Government stocks for other issues which will give them a higher return. The enormous rises which have occurred in some of the raw materials—tin and rubber as examples—help to encourage speculative investment.

A. Reyrolle and C. A. Parsons

A. Reyrolle hold 40 per cent of the capital of C. A. Parsons, and the association of the two companies is matched by the close correspondence between the prices of the shares concerned. These have climbed steadily in recent weeks to a common level of about 72s 6d, the best for some years. They stand high in the list of shares on which the market banks for a better return sooner or later; and, with the dividend freeze thawing visibly round the edges, present investment in the industrial markets is thought to be taking such considerations increasingly into account. Both companies paid a total of 15 per cent for 1949, from earnings of well over 100 per cent; and in each case the interim was maintained in September at 7½ per cent. Yields of about £4 2s 6d per cent do credit to the conservative character of the dividends, and the general qualifications of the shares.

Hackbridge & Hewittic

In rising to 16s, this company's 5s shares have reached about the best price realised since the firm was made public in 1947. The latest improvement follows the declaration of a 5 per cent interim dividend on account of the year ending next March. It compares with the corresponding distribution of 4 per cent for 1948–49, for which year the total was brought up, in June, to 15 per cent—a 2½ per cent improvement on the preceding payment. According to the last annual accounts and report, earnings were at the rate of over 40 per cent on the half-million ordinary capital, and the order book in all departments was at a record level. Net liquid assets were only just short of the million mark. The shares are on a yield basis of £4 13s 9d per cent, without any allowance for the possibility that the higher interim may be the precursor of a larger total for the year.

Burco Results

A remarkable expansion in Burco's profits results in a modest increase in the ordinary shareholder's return, a 7½ per cent bonus being added to the 35 per cent dividend paid since the war. Since the bonus involves the distribution of less than £5,000 net out of a £26,000 increase in taxed profits, it comes well within the prevailing rule of "moderation and restraint," while being welcome as a tangible reward for a very successful year's trading. The prices of the 5s shares responded with a rise of 1s 9d to 23s 9d at which they show a yield of nearly 9 per cent on the total payment.

Price Changes on the Week

Falk Stadelmann at 38s 9d are 1s 3d better and Hoovers at 49s 6d have gained the same amount. Electric Constructions are similarly harder at 60s, the yield of 5 per cent on the money attracting buyers. Automatic Telephones, 62s, Crabtree, 39s, and Hackbridge Cable, 14s 9d, have each gained a few pence. Telegraph Constructions hardened to 41s 6d. Metal Industries rallied to 42s. Brush Electric are a shade better at 6s 6d. On the other side of the sheet, Murex eased off to 48s 9d, and there are small falls in Lucas, 32s 6d, Decca, 15s, Ever Ready, 29s, and Palestine Electric, 22s. Cable & Wireless 4 per cent unsecured loan stock shaded off to 101. Interest in the ordinary stock, now 93, has lately been very passive. Calcutta Trams, 33s 9d, have lost 2s 9d of their recent gain. Cape Electric Trams at 15s are up 1s 3d. Oriental Telephones, now 45s, are 1s 3d down on the week.

Stock on Offer

At present on offer are useful lines of the well-covered 4¼ per cent preference shares of G.E.C. and Laurence, Scott Electromotors, the former at 21s, to yield just over 4 per cent, and the latter at 20s 3d to yield 4 guineas per cent. Returns of 5½ per cent are available from Ever Ready 7 per cent preference, which are receiving an extra 3 per cent through their participating rights, at 36s 3d, and from Brush Electric 5½ per cents at par. Among the less active electrical ordinary shares may be mentioned offers of Watford Electric 2s shares at 7s 1½d, paying £5 12s 3d per cent, and of Switchgear & Cowans 5s shares, at 15s 9d, on which the return is £6 7s per cent.

NEXT WEEK'S EVENTS

Monday, 13th November

BIRMINGHAM.—Imperial Hotel, Temple Street, 6 p.m. I.E.E. South Midland Supply and Utilization Group. "A Review of Research in Electricity Supply," by C. W. Marshall.

BRISTOL.—Electricity House, Colston Avenue, 6 p.m. I.E.E. Western Centre. "Some Problems in Aircraft Magneto Development," by R. T. Coe and D. F. Welch.

LIVERPOOL.—Exchange Hotel, 6.30 for 7 p.m. I.E.E. Mersey and North Wales Centre. Annual dinner and visit of President.

NEWCASTLE-ON-TYNE.—Neville Hall, Westgate Road, 6.15 p.m. I.E.E. North-Eastern Centre. Discussion of Report on "The Education and Training of Electrical Technicians." To be presented by F. R. Livock.

Tuesday, 14th November

BELFAST.—Queen's University, 6.45 p.m. I.E.E. Northern Ireland Centre. "Electricity in the Cotton Industry," by F. W. Cox and W. E. Swale.

CAMBRIDGE.—Cavendish Laboratory, 8.15 p.m. I.E.E. Cambridge Radio Group. Address by the chairman of the Radio Section, Mr. C. F. Booth.

GLASGOW.—At the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, 7 p.m. I.E.E. Scottish Centre. "The Application of Gas-Turbine Technique to Steam Power," by J. F. Field.

LEEDS.—B.E.A. Yorks. Division, 1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Centre. "Design of Power Transformers to withstand Surges due to Lightning, with special reference to a New Type of Winding," by A. T. Chadwick, J. M. Ferguson, D. H. Ryder and G. F. Stearn.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Measurements Section. "The Determination of Time and Frequency," by H. M. Smith; "Frequency Standardization," by Dr. L. Essen. (Joint meeting with Radio Section.)

Lighting Service Bureau, 2, Savoy Hill, W.C.2, 6 p.m. Illuminating Engineering Society. "The Lighting of the House of Commons," by C. Dykes-Brown.

MANCHESTER.—Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Centre. "The Design and Operation of a 30-MeV Synchrotron," by D. W. Fry, J. Dain, H. H. H. Watson and H. E. Payne.

STOKE-ON-TRENT.—31, Kingsway, 6 p.m. I.E.S. Stoke-on-Trent Group. "Care and Maintenance of Fluorescent Lamps," by A. G. Mitchell.

WIMBLEDON.—Compton Hall, Compton Road, 8.15 p.m. A.S.E.E. South West London Branch. "Relays and Remote Control," by Dr. W. L. Stern.

Wednesday, 15th November

LEEDS.—Y.M.C.A. Buildings, Albion Place, 7 p.m. I.E.S. Leeds Centre. "Radiation, Light and Illumination," by J. N. Aldington.

LONDON.—Savoy Place, W.C.2. I.E.E. Utilization Section. Conference on "Electricity as an Aid to Productivity." (Continued on 16th November.)

LUTON.—Chamber of Commerce, George Street West, 7.30 p.m. Luton Electrical Society. "Developments in Aircraft Electrical Equipment," by E. R. Legg.

MANCHESTER.—Engineers' Club, Albert Square, 7.30 p.m. A.S.E.E. Manchester Branch. "Lighting and Colour on the Stage," by P. Corry.

MIDDLESBROUGH.—Cleveland Technical Institution. I.E.S. Tees-side Group. "Floodlighting Practice," by M. W. Peirce.

SHEFFIELD.—Grand Hotel, 6.30 p.m. I.E.E. Sheffield Sub-Centre. Discussion on "Electrical Equipment of Cold Rolling Mills." (Joint meeting with Yorkshire Branch of I.Mech.E.)

SOUTHAMPTON.—University College, 6.30 p.m. I.E.E. Southern Centre. "The Application of Electric Discharge Lamps to Daylight Signalling," by H. K. Bourne and E. J. G. Beeson.

Thursday, 16th November

BIRMINGHAM.—M.E.B. Showrooms, Paradise Street, 7 p.m. E.P.E.A. Midland Technical Group. "Electric Furnaces."

DUBLIN.—Trinity College, 6 p.m. I.E.E. Irish Branch. "The Chemist and Metallurgist in a Transport Company," by G. H. Burnell.

GLOUCESTER.—Cadena Café, Eastgate Street, 6.30 p.m. I.E.S. Gloucester and Cheltenham Centre. "Lighting in the Home," by Miss M. Wardlaw.

HARROGATE.—British Institute of Management. Autumn Conference. (Continued on 17th, 18th and 19th November.)

HULL.—Y.E.B., Ferensway, 7.30 p.m. I.E.E. North Midland Centre. District meeting. "Automatic Control of Lead-Acid Battery Charging Equipment," by R. A. Harvey.

KETTERING.—George Hotel, 7.30 p.m. I.E.E. East Midland Centre. "The Development and Design of Electrical Control Gear for Machine Tools," by A. R. H. Thorne.

Friday, 17th November

NEWCASTLE-ON-TYNE.—King's College, 6.30 p.m. I.E.E. North Eastern Students' Section. "Brazing by Electricity," by L. C. Kerr; "Electricity Distribution," by A. Jackson.

Saturday, 18th November

LONDON.—Victoria Halls, W.C.1. 7.15 p.m. I.E.E. London Students' Section. Dance.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s. each) may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1944

14131. Foxboro Co.—Electrical bridge measuring apparatus. 24th July, 1944. (646981.)

24028. General Electric Co., Ltd., and Ollerenshaw, C.—Relay arrangements of the kind in which an electromagnetic relay is arranged to be operated in dependence upon the phase difference between two alternating current signals. 13th October, 1947. (647240.)

1946

11527. British Thomson-Houston Co., Ltd.—Control systems for electric circuit-breakers. 15th April, 1946. (647242.)

17522. Radio Corporation of America.—Electronic apparatus for detecting or measuring minute mechanical movements and for like purposes. 11th June, 1946. (647243.)

21845. British Thomson-Houston Co., Ltd.—High-frequency heating apparatus. 22nd July, 1946. (647244.)

30929. Lowell & Grayson Manufacturing Co.—Thermostatic valve devices. 17th October, 1946. (647248.)

31063. British Thomson-Houston Co., Ltd.—Pulse amplifiers. 18th October, 1946. (647125.)

31075. Western Electric Co., Inc.—Combined radar and signal transmission systems. 18th October, 1946. (647126.)

33981. Standard Telephones & Cables, Ltd.—Calibration of apparatus for indicating relative amplitude relation of signals of different frequencies in a radio beacon receiver. 15th November, 1946. (647279.)

1947

4016. Soc. Francaise Radio-Electrique.—Stabilizing arrangements for electrical supply systems. 11th February, 1947. (647131.)

5462. Akt.-Ges. Brown, Boveri & Cie.—Fluid-blast circuit-breakers for interrupting high-voltage direct currents. 25th February, 1947. (647132.)

6467. Standard Telephones & Cables, Ltd.—Electric discharge tube. 7th March, 1947. (647134.)

7696. Philco Corporation.—Directional antenna systems. 20th March, 1947. (647136.)

8013. Philips Lamps, Ltd.—Amplifying circuits. 24th March, 1947. (647055.)

8340. Philips Lamps, Ltd.—Electrical amplifier circuit-arrangements. 27th March, 1947. (647195.)

8341. Philips Lamps, Ltd.—Electrical amplifiers. 27th March, 1947. (647196.)

10238. British Thomson-Houston Co., Ltd.—Antennae. 17th April, 1947. (647198.)

12617. Standard Telephones & Cables, Ltd.—Frequency discriminators. 9th May, 1947. (647199.)

12843. Marconi's Wireless Telegraph Co., Ltd.—Automatic tuning mechanism for radio receivers or the like. 15th May, 1947. (647201.)

21701. Sylvania Electric Products, Inc.—Unitary stem and contact bases for electron tubes and the like. 7th August, 1947. (647255.)

21702. Sylvania Electric Products, Inc.—Composite glass-metal alloy article. 7th August, 1947. (647256.)

21703. Sylvania Electric Products, Inc.—Metal insert for vacuum-tight sealing. 7th August, 1947. (647257.)

22235. Standard Telephones & Cables, Ltd., Anglo Iranian Oil Co., Ltd., Hill, S. S., and Rubach, A.—Amplifying arrangements for coupling a balanced-to-ground electric signal transmission circuit to an unbalanced circuit. 11th August, 1947. (647060.)

22880. Anglo-Iranian Oil Co., Ltd., and Beaumont, F. N.—Apparatus for electric arc welding of pipes and like articles. 27th July, 1948. (647157.)

23509. Ateliers de Constructions Electriques de Charleroi.—Receiver equipment for teleprinters. 26th August, 1947. (647260.)

23767. Oldham & Son, Ltd., and Akroyd, H.—Transportable electric lighting units. 11th October, 1948. (647262.)

26531. Metropolitan-Vickers Electrical Co., Ltd., Miller, C. W., and Crowley-Milling, M. C.—Apparatus for plotting the directional characteristics of wave propagating and/or receiving devices, such as radio aerials. 19th October, 1948. (647064.)

28496. Radio Corporation of America.—Electronic transducers. 24th October, 1947. (647152.)

28696. Van Der Heem, N.V.—Small electric machine. 27th October, 1947. (647267.)

29434. Standard Telephones & Cables, Ltd., Wright, E. P. G., Ronayne, J. B., and Gordon, K. S.—Equipment for recording particulars regarding telecommunication connections. 29th October, 1948. (647269.)

29650. Schmukler, A., and Schmukler, B.—Electrical metal polishing and the like devices. 6th November, 1947. (647070.)

31851. Philips Electrical, Ltd.—Circuits for receiving frequency-modulated oscillations. 2nd December, 1947. (646997.)

32724. Portella, C. V.—Starter or starting switch for single-phase induction split-phase motors. 11th December, 1947. (647274.)

33603. Sperry Gyroscope Co., Inc.—Electrical servo-motor systems. 19th December, 1947. (647230.)

33675. Drake & Gorham, Ltd., and Smallbone, J.—Electrical communication systems. 20th December, 1948. (647001.)

33820. Philips Electrical, Ltd.—Cathode-ray tube. 22nd December, 1947. (647003.)

34375. Aktiebolaget Elektrolux.—Dish washing machines. 29th December, 1947. (647232.)

34846. Staatsbedrijf der Posterijen Telegrafie en Telefonie.—Arrangement for providing particular characteristics in a line circuit. 30th December, 1947. (647073.)

1948

2297. British Thomson-Houston Co., Ltd.—High-power electric discharge tubes. 26th January, 1948. (647233.)

4484. British Thomson-Houston Co., Ltd.—Impedance switching devices. 16th February, 1948. (647077.)

5943. Director of the Office of Technical Services of Department of Commerce.—Frequency control of high-frequency oscillators. 27th February, 1948. (647015.)

7604. Dehn, S. G. (Sunbeam Corporation).—Electrically heated coffee maker. 12th March, 1948. (647087.)

11157. Jones & Co. (Engineers), Ltd., W., Clark, G. C., and Jones, H. H.—Cam followers for telephone and like contact springsets. 12th April, 1949. (647099.)

14752. British Vacuum Cleaner & Engineering Co., Ltd., and Briggs, G.—Electronic amplifiers. 7th June, 1948. (647235.)

15696. Foxboro Co.—Electric measuring apparatus. 24th July, 1944. (647025.)

17289. English Electric Co., Ltd., and Roberts, W. R. J. B.—Means for testing electrical ignition systems of internal-combustion engines. 28th June, 1949. (647115.)

19205. Baker Platinum, Ltd., and Dowson, A. G.—Tipped electrodes for sparking plugs, and their manufacture. 12th July, 1949. (647170.)

19770. Hazeltine Corporation.—Multiple-tuned wave-selector system. 23rd July, 1948. (647172.)

20364. Lange, E.—Fluid-blast electric circuit-breakers or switches. 30th July, 1948. (647177.)

20440. Bannister, L. H.—Electrical storage apparatus. 18th July, 1949. (647030.)

21604. British Thomson-Houston Co., Ltd.—Telemetering transmitting apparatus. 16th August, 1948. (647184.)

23543. British Thomson-Houston Co., Ltd., and Mills, R. V.—Operative combination of low pressure electric discharge and incandescent lamps. 9th August, 1949. (647033.)

24278. General Electric Co., Ltd., and Turrall, J. C.—Electrically driven locomotives. 15th September, 1949. (647037.)

25675. Mann, J. W., and Russell, G. F.—Radio-frequency parallel bonding. 1st October, 1948. (647045.)

26474. Watson, C.—Conductor crossings and the like of overhead wires for electric traction vehicles. 5th October, 1949. (647047.)

28045. Belling & Lee, Ltd., and Strafford, F. R. W.—Electric fuses. 31st May, 1949. (647049.)

28200. Automatic Telephone & Electric Co., Ltd., and Rayner, T. R.—Electrical protective arrangements. 7th September, 1949. (647050.)

SWISS ELECTRICAL EXPORTS

General Increase in 1949

THE electrical export trade of Switzerland continued to progress last year, and all leading lines except telegraph and telephone apparatus shared in the advance. Increases in dynamo-electric machinery, meters and instruments and much unspecified apparatus were substantial. Besides replenishing European countries affected by the war Switzerland has been exporting to a large number of Latin American lands and to India.

Class of Goods	1949 Sw. fcs. (000)	Inc. or dec. on 1948
Accumulators	2,684	+ 1,064
To France	476	+ 372
„ *Italy*	222	+ 145
„ *Holland*	390	+ 200
„ *Argentina*	217	+ 73
Dynamo-electric machines	81,183	+ 19,523
To Finland	3,888	+ 2,489
„ *Germany*	1,028	+ 906
„ *Norway*	6,458	+ 3,081
„ *Czechoslovakia*	1,749	+ 1,441
„ *Sweden*	4,426	— 412
„ *Belgium-Luxemburg*	7,451	+ 2,499
„ *Portugal*	2,540	+ 1,232
„ *Argentina*	4,568	+ 1,713
„ *Brazil*	6,375	+ 2,440
„ *India*	2,948	+ 1,848
„ *Eire*	1,358	+ 461
„ *Poland*	7,707	+ 6,248
Insulators	1,770	+ 805
To Holland	595	+ 287
„ *Poland*	107	+ 83
„ *S. Africa*	219	+ 219
„ *Austria*	103	+ 79
Meters and measuring instruments	29,868	+ 4,138
To France	2,588	+ 976
„ *Italy*	2,003	+ 223
„ *Belgium-Luxemburg*	4,390	+ 1,393
„ *Holland*	2,830	— 589
„ *India*	1,884	+ 1,098
„ *Argentina*	2,765	— 564
Insulated wire and cable	3,981	— 129
To Yugoslavia	974	+ 949
„ *Belgium-Luxemburg*	608	— 157
„ *Austria*	363	+ 6
„ *France*	175	— 214
„ *Sweden*	270	— 123
Telegraph and telephone apparatus	7,891	— 2,089
To Holland	2,279	— 3,545
„ *France*	651	+ 275
„ *Italy*	634	+ 152
„ *Yugoslavia*	518	+ 388
„ *Brazil*	460	+ 144
„ *Uruguay*	975	+ 925

Class of Goods	1949 Sw. fcs. (000)	Inc. or dec. on 1948
Radio apparatus	8,554	+ 1,354
To Germany	2,357	+ 2,311
„ *France*	724	— 330
„ *Holland*	713	+ 127
„ *Poland*	629	+ 577
„ *Hungary*	669	+ 567
„ *Argentina*	603	+ 488
Elec. incandescent lamps	654	— 76
To Austria	65	— 111
„ *Germany*	225	+ 186
„ *Italy*	70	+ 45
Unspecified electrical apparatus over 500 kg.	12,881	— 89
To Holland	1,557	+ 852
„ *Spain*	741	— 2,224
„ *Norway*	2,144	+ 1,540
„ *Sweden*	1,355	+ 20
„ *Turkey*	381	+ 181
„ *Brazil*	876	+ 526
„ *Poland*	595	+ 193
„ *France*	799	— 956
Ditto 50 to 500 kg.	15,538	+ 5,068
To France	841	— 108
„ *Belgium*	1,980	+ 1,134
„ *Holland*	1,399	+ 24
„ *Spain*	1,003	+ 448
„ *Turkey*	412	+ 182
„ *Sweden*	637	— 348
„ *Brazil*	864	+ 159
„ *Finland*	873	+ 348
„ *South Africa*	792	+ 703
Ditto 3 to 50 kg.	21,943	+ 7,243
To France	1,805	+ 555
„ *Belgium*	3,134	+ 2,204
„ *Holland*	2,810	+ 1,340
„ *Sweden*	783	— 147
„ *Norway*	929	+ 535
„ *Finland*	783	— 119
„ *Brazil*	1,110	+ 306
Electric locomotives	1,973	— 1,567
To Belgium-Luxemburg	1,074	+ 1,074

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section, the date of the issue is given in parentheses.

Australia.—15th December. Brisbane City Council. 400 11 kV single-phase 50-cycle lightning arrestors. (C.R.E. (I.B.) 68787/50. Ten/1819.)*

Bedfordshire.—28th November. County Education Committee. Electrical installation at Pearcey Road C.P. school, Bedford. (See 3rd November issue.)

Dudley.—Corporation. Street lighting equipment. (See this issue.)

Gillingham.—Corporation. Electrical installations in 105 houses. (See this issue.)

Greece.—ATHENS.—Greek Government. Design and supervision of construction of transmission lines, sub-stations and distribution systems. (See this issue.)

Houghton-le-Spring.—U.D.C. Electric radiators, washboilers and cookers for 58 houses on the Racecourse and Barnwell estates.—Surveyor, Newbottle Street.

India.—15th December. Madras Electricity Department. Power line carrier current equipment and v.h.f. radio equipment for Machkund hydro-electric scheme. (C.R.E. (I.B.) 66623/50. Ten/1802.)*

Isle of Ely.—14th December. County Council. Electrical installation in Downham Road School, Ely. (See this issue.)

New Zealand.—13th March, 1951. State Hydro-Electric Department. Auxiliary generator sets for Roxburgh power station. (C.R.E. (I.B.) 67647/50. Ten/1757.)*

Sedgley.—14th November. U.D.C. Steel or concrete columns, together with 250 W mercury vapour lamps, etc. W. M. Jones, surveyor.

South Africa.—29th November. Railways Stores Department. Two electric hoists. (C.R.E. (I.B.) 68682/50. Ten/1812.)*

18th January. Cape Town Electricity Department. Overhead line material. (C.R.E. (I.B.) 68619/50. Ten/1808.)*

United States.—1st May. United Nations, Lake Success. 2,500 headphones. (C.R.E. (I.B.) 68722/50. Ten/1811.)* 440 microphones. (C.R.E. (I.B.) 68723/50. Ten/1810.)*

Wakefield.—22nd November. Street lighting equipment. (See this issue.)

Washington (Durham).—U.D.C. Electrical installations in 12 houses in Blue House Lane. Council's surveyor.

*Specifications may be inspected at the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, S.W.1 (Victoria 9040).

ORDERS PLACED

Newcastle-on-Tyne.—Tyne Improvement Commission. Supply of five ten-ton electric cranes for a proposed iron ore discharging quay at Tyne Dock (£257,500).—Stothert & Pitt, Ltd.

Sheffield.—Transport Committee. Recommended. Electrical installation at the Herries Road bus garage (£4,574).—Hall & Stinson, Ltd.

Housing Committee. Electrical installations in 318 houses (£5,906) and 418 houses (£7,601), Stradbroke estate; 48 old people's dwellings, Stradbroke estate (£1,030) and 44 at Manor Park estate (£944).—Hall & Stinson, Ltd.

Corporation. Electrical installations in 16 police houses (£344).—A. Holmes. Recommended. Installation of electric lighting at Acres Hill county infants' school (£2,150).—Yorkshire Electricity Board.

Swansea.—Corporation Education Committee. Electrical installation works at new Cockett secondary modern boys' school (£2,275).—Hartley Electromotives, Ltd.

Whitley Bay (Northumberland).—U.D.C. Installation of street lighting in Shields Road and Seatonville Road (£1,030).—Revo Electric Co.

Wisbech.—East Anglian Regional Hospital Board. Electrical engineering services at extensions to Bowthorpe Hall Maternity Home (£5,089).—P. H. Allin & Sons, Cambridge.

CONTRACTS IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Aberystwyth.—Conversions at Queen's Hotel, Marine Terrace, for county offices, for Cardiganshire C.C.; county architect, Cambrian Chambers, Aberystwyth.

Ammanford.—Technical and county college (£165,000) for Carmarthen E.C.; county architect, County Hall, Carmarthen.

Banbury.—Extensions to Horton General Hospital; Oxford Regional Hospital Board, 43, Banbury Road, Oxford.

Banstead.—Flats (32), in five blocks, Tadworth, for U.D.C.; A. W. Kenyon, architect, 15, Adeline Place, Bedford Square, London, W.C.1.

Bexhill.—Three-storey premises, Devonshire Road; Montague Burton, Ltd., Hudson Road Mills, Leeds.

Bilston.—Houses (72), Stowlawn, and eight flats, Temple Street; borough architect, 20, Wellington Road.

Birkenhead.—Houses (22), Mount estate; E. Atkinson, Greasby Road, Greasby.

Bradford.—Extensions to Bede's Grammar School, Heaton; J. H. Langtry-Langton, architect, 8, Oak Mount, Manningham.

Brierley Hill.—Municipal offices for U.D.C. (£70,000); J. R. Moore, architect to Council.

Bromley.—Primary junior school, Sough-borough Lane; borough engineer.

Bury St. Edmunds.—Modern secondary school, Beyton, for West Suffolk E.C.; county architect, 13, Westgate Street, Bury St. Edmunds.

Cardiff.—Secondary modern school, Bridge Road; I. Jones and J. Bishop, architects, 6/7, St. John's Square.

Carlisle.—Additions to grammar school (£10,000); city engineer, 18, Fisher Street.

Carshalton.—Flats (84), Lynwood Avenue, Coulsdon, for U.D.C.; J. W. Wright, clerk, The Grove.

Celyn.—Horticultural centre for Flintshire C.C. (£60,000); deputy county architect, Mold.

Cheadle.—Cement works, Cauldon Low; British Portland Cement Manufacturers, Ltd.

Cheltenham.—Primary school, Rowanfield; Gloucestershire county architect, Shire Hall, Gloucester.

Coventry.—Houses, etc. (1,067), Tile Hill; Geo. Wimpey & Co. Ltd.

Darlington.—Houses (350); borough architect, Central Buildings.

Derby.—Factory for E. W. Bliss (England), Ltd.; Gee Walker & Slater, Ltd., Uttoxeter Old Road.

Doncaster.—Office block; T. Wall & Sons, Ltd., Chequer Road.

Exeter.—Stores, Fore Street; British Home Stores, Ltd., 129, Marylebone Road, N.W.1.

Great Yarmouth.—Houses (98), Magdalen College estate, Gorleston; borough architect, 15, Regent Street.

Hamilton.—Reconstruction of garage, workshops and offices, Bothwell Road (£55,000), for Central S.M.T. Co., Ltd., Motherwell; W. Basil Scott, architect, 19 Waterloo Street, Glasgow.

Harpenden.—Experimental building (£90,000); Lawes Agricultural Trust, Rothamsted Experimental Station.

Harrow.—Houses (172), Northolt Park; U.D.C. surveyor.

Hull.—Departmental store, Bond Street; Edwin Davis & Co., Ltd., 13, Savile Street.

Ilkley.—Adaptations at Wells House, for training college for teachers of domestic science (£148,000); West Riding county architect, Wakefield.

Keighley.—County junior school, Bracken Bank estate; borough architect.

Leeds.—Children's homes, Belle Isle, Ireland Wood and Beckett Park estates; city architect.

Primary school, Low Farm, Adel; N. R. Paxton, architect, 11, Cavendish Place.

Litherland.—Houses (20), Sonning Avenue, for U.D.C.; A. T. Jones, Hatton Hill estate offices, Litherland.

London.—Fulham.—Dwellings (88), Fane Street; Fulham Housing Society, Ltd., 91, Dawes Road, S.W.6.

West Norwood.—Block of 30 flats, York Hill, for L.C.C.; Gilbert-Ash, Ltd., builders, 2 Stanhope Gate, W.1.

Manchester.—Factory at Northenden for Sorenson Bakery Equipment Co., Ltd.; Moss & Sons, Leigh, Lancs.

Newbury.—Houses (126), Love Lane; borough surveyor.

Portland.—Houses (76) and 20 flats, Verne Common, for U.D.C.; Reema Constructions, Ltd., Milford Manor, Salisbury.

Portsmouth.—Rebuilding shops, Arundel Street, Landport; Timothy Whites & Taylors, Ltd., 70, Vauxhall Bridge Road, London, S.W.1.

Sheffield.—Dental hospital, Glossop Road, for United Sheffield Hospitals Board; Adams, Holden & Pearson, architects, 2, Gordon Square, W.C.1.

Stanley (Durham).—Houses (50), South Stanley; U.D.C. surveyor.

Tow Law.—Houses (24), on the Deerness estate; U.D.C. surveyor.

Trumpington.—Technical college and school of art (first instalment to cost £250,000); county architect, Shire Hall, Castle Hill, Cambridge.

Truro.—Area hospital, Gloweth; South Western Regional Hospital Board.

Watford.—Factory, Lower High Street; Bedford Products & Light Engineering Co., Otterpool Way.

Wednesbury.—Additions and extensions, Holyhead Road Factory, Moxley; Rubery Owen & Co., Ltd., Darlaston, Staffs.

West Cumberland.—Two factories for the West Cumberland Industrial Development Board, Roper Street, Whitehaven.

Whitehaven.—Houses (38), Valley estate; John Laing & Son, Ltd., Carlisle.

Willenhall.—Houses (84), Coltham Road estate, for U.D.C.; housing architect, Town Hall.

Wolverhampton.—County primary school, Castlecroft, Tettenhall, for Staffs E.C.; A. C. H. Stillman, county architect, Lichfield Road, Stafford.

Wrexham.—Houses (50), Cefn Mawr, for R.D.C.; J. Brian Cooper, architect, 177 Corporation Street.

Yorkshire.—Schools at Aston, Sheffield and Dale Lane, Heckmondwike; West Riding county architect, Bishopgarth, Westfield Road, Wakefield.

E.A.W. Activities

TWO special courses are now in progress at E.A.W. headquarters. On Tuesday afternoons a series of lecture-demonstrations is being given to members of the London Branch and also to non-members. The course includes fuse mending, correct maintenance, and a working knowledge of domestic appliances. It is hoped that students will enter for the E.A.W. Home Workers' Examination, but this is not compulsory. On Wednesday evenings a series of six practical classes in electrical housecraft is being held for teachers.

A new chart is now available from the Electrical Association for Women illustrating the construction of the immersion type electric kettle. The chart shows a cut-out section of the kettle with the element in place, and also a detailed diagram of the element itself. Printed in five colours, linen backed, varnished and mounted for wall hanging, the new chart measures 19½in by 30in and costs 4s 6d post free. A companion chart will shortly be available illustrating the electric kettle with enclosed element.